SIXTEENTH BIRTHDAY NUMBER

DISCOVERY

A Monthly Popular Journal of Knowledge

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DISCOVERY

A Monthly Popular Journal of Knowledge

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Notes of the Month.

The opening of Discovery's seventeenth year of service to the cause of knowledge coincides with a period of political discussion concerning frontiers, national aspirations, and so forth. We may be accused of triteness in reiterating the truism that Science knows no frontiers; but it would certainly be refreshing to the ordinary non-political man of intelligence if the statesmen who are his leaders would occasionally take their text from the scientists' books. Only last month the centenary of Ampère brought together in common homage the men of science of twenty nations; and a generous gesture of the University of Cambridge to Professor Kapitza when he was recalled to his own country is still alive in the memory. But in these days when government service has become an end in itself, rather than a means to an end, men of learning have still a long way to go before they can persuade their lay-colleagues to broaden their outlook.

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Sir Ernest Benn's writings and speeches have established him as the leader of individualist thought in this country. His first book, *The Confessions of a Capitalist*, has become an economic classic, and he has been so unwearying in his campaign for Man versus the State that his tenth volume has just been published. It is entitled, *Modern Government* (Allen & Unwin, 6*s.*), and the sub-title, "As a Busybody in Other Men's Matters," gives the key, if one were needed, to the aspect of the subject which Sir Ernest Benn has set out to explore. The main argument, as he states it, is that the best government is that of which there is the least. It follows that Sir Ernest Benn finds government as practised in the twentieth century encrusted with gross excesses, which he proceeds to attack persuasively, wittily, and with formidable force. He is more particularly concerned to expose the folly of government action in the economic sphere.

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He points out that there are great vested interests in the State, chief among them the Civil Service and the Board of Education. "Many teachers," he says, in a telling phrase, "have turned trade unionists, and a corresponding number of old teachers are turning in their graves." Herein lies the moral for the scientist and the man of letters. Are they to become servants of the State, who should be servants of Mankind? It is the proud boast of the man of learning that his vocation knows no nationality. Is Science now to be fettered, not by frontiers only but by petty regulations? The evils of bureaucracy have their concentrated essence in the words of a minor official, "I am prepared to allow." The implications of a phrase like this, in Sir Ernest Benn's view, are responsible for much of our commercial inactivity; we feel that they can lead also to the miscarriage, if not the utter sterility, of Science.

* * * *

Under the Order in Council dated 6th February, 1928, the Lord President of the Council has appointed Professor A. C. Seward, Sc.D., D.Sc., LL.D., F.R.S., to be a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. Professor Seward, as a Trustee of Discovery, and as a regular contributor to our journal, is an old friend of our readers, and we feel sure they will gladly join with us in congratulating him on his important appointment.

* * * *

The Academic Assistance Council, which was formed in May, 1933, to assist scholars and scientists who, on grounds of religion, race or opinion, were unable to

continue their work in their own country, has decided to establish as its permanent successor a Society for the Protection of Science and Learning, which will continue the Council's various forms of assistance to scholars. One function of the Society will be to build up an Academic Assistance Fund to award research fellowships, tenable in the Universities of Great Britain and other countries by the most distinguished of the refugee scholars. Lord Rutherford, as President of the Council, now issues a strong appeal for this fund, which will be administered under the auspices of His Grace the Archbishop of Canterbury, the President of the Royal Society, the President of the British Academy, Lord Horder, the Hon. R. H. Brand, and himself.

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The appeal, which is addressed to all those wishing to assist in the defence of free learning, is made with the full co-operation of the organisers of the National Christian appeal which is about to be made for the destitute non-Jewish refugees from Germany, since the Society will be giving assistance to only one section, namely, the scholars, among the German refugees, irrespective of their religious affiliations. The minimum annual subscription to the fund is one guinea, and Lord Rutherford hopes that many larger donations will be made, earmarked if desired for the establishment of particular fellowships. Contributions should be sent to him at the Offices of the Academic Assistance Council, 12, Clement's Inn Passage, W.C.2, made payable to the "Academic Assistance Council."

* * * *

Last December we recorded the appointment of Dr. L. W. G. Malcolm to the new post of Organiser of Museums to the London County Council, and ventured to predict that something in the way of co-ordination between museums and schools might be the result. Dr. Malcolm has now prepared a brief *Survey of Museums and Art Galleries in London* (L.C.C. Publication No. 3172. 4*d*.), which contains, in addition, a foreword by E. M. Rich, Education Officer to the Council, explaining the modern movement to utilise, in the service of education, the potential teaching material in the museums. The survey will be of interest to the general public, and of great value to teachers, who will be able (among more everyday matters) to track down the whereabouts of a quinterna, a miniature swill-room, or drugs used in the manufacture of galenicals—all for the benefit of their youthful charges.

* * * *

The study of diet and nutrition seems at last to be taking the important place it deserves in the public attention, some recent publications having brought the question of food in relation to health under the searchlight of the Press. Sir John Orr's report on a survey of adequacy of diet in relation to income, entitled *Food, Health, and Income* (Macmillan. 2*s*. 6*d*.), is a challenge, not only to physicians and economists, but also to farmers and food-distributors, and even to politicians, to look to the improvement of the health of the rising generation. At the same time the *Report of the Medical Research Council*, 1934-35 (H.M. Stationery Office. 3*s*.), contains an important section on nutrition. Statistical diagrams and medical research lead to the same conclusion: that under-nutrition is present but not prevalent in this country; and that for the income-groups below the adequacy level an increased consumption of milk, butter, eggs, fruit, vegetables, and meat is desirable.

* * * *

Appropriate to the occasion is the examination of the position made in the *Lancet* by Dr. Robert Hutchison, President of the Royal Society of Medicine. An interesting point which he makes is that while diseases associated with under-nutrition (tuberculosis, etc.) are steadily decreasing here, those associated with good nutrition—not to say over-nutrition—(diabetes, etc.) are on the increase. A balanced diet, not merely a copious one, is indicated. Dr. Hutchison's conclusion is that poverty is only one cause of malnutrition to-day, and probably not a common one at that. Two recently published books should be read by all interested in this vital problem. These are *Food, Health, Vitamins*, by R. H. A. Plimmer and V. G. Plimmer (Longmans. 3*s*. 6*d*.), a handy volume now in its seventh edition, and *Vitamins in Theory and Practice*, by Dr. Leslie Harris (Cambridge University Press. 8*s*. 6*d*.), a beautifully printed and brilliantly illustrated book, which presents many vital and often out-of-the-way facts in language that all can follow.

* * * *

The current issue of the *Bulletin of the Imperial Institute* (Murray, 3*s*. 6*d*.), being the last of Vol. 33, contains the announcement that, beginning with No. 1 of Vol. 34, publication is being taken over by the Imperial Institute itself. The present number includes the result of some interesting experiments in paper-making. Among the new materials tried were the Common Reed (*Phragmites communis*) and "Chique Reed" (identified at Kew as *Phalaris arundinacea L.*), both of which are of frequent occurrence in Britain, especially in Norfolk. Though pulp of fair quality was obtained from the reeds, the manufacturers' reports on its use commercially were not encouraging, and it seemed unlikely that the price that could be offered would cover the cost of collection and transport.

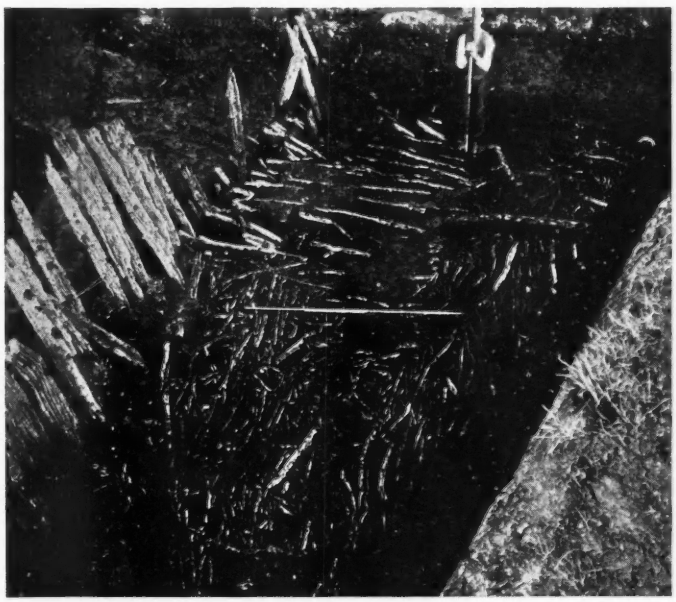
State Excavations in Ireland, 1935.

By Seán P. Ó Ríordáin, Ph.D.

National Museum of Ireland.

We are fortunate in being able to continue our survey of Irish excavation, in which unemployed labour is utilised as part of a national scheme. The author's account of the year's work is written with the knowledge of the man on the spot, and it is good to read that another fruitful season lies ahead of him. For the drawings we are indebted to Miss G. Hayes.

In an article on *Recent Irish Excavations* published in Discovery in April, 1935, a summary was given of the results of the archæological excavations conducted in 1934 under the scheme initiated by the Free State Government and financed as part of the plan for relieving unemployment. This scheme was continued in 1935 and it is the purpose of the present article to deal briefly with the results. A total of eleven sites was investigated, of which five had already been begun in the previous year. We shall deal with these first and shall then turn our attention to the new sites undertaken in 1935.



Dunshaughlin crannóg during excavation, showing the brushwood layer, the overlying timbers, and the outer palisade.

A cairn near Baltinglass, Co. Wicklow, in which in the previous year was found a stone with spiral ornament, revealed several further examples of such ornament or of concentric circles. Sherds of bronze age pottery were found, and evidences of cremated burials. At Aghnaskeagh, Co. Louth, the second (Cairn B) of a group of megalithic cairns was excavated. As in the case of Cairn A, excavated in 1934, a monument of megalithic character was found to have associations of Early Iron Age date. Four megalithic chambers were uncovered and among the finds were sherds of neolithic pottery. That the site had been occupied at a later date by people in an iron-using state of culture was shown by the finding of a considerable amount of iron slag, and a burial of this period was attested to by a cremation contained in a bucket-type Hallstatt urn, which had been placed against the collapsed slab of the earlier burial-chamber.

The complex series of earthworks, partly excavated in the earlier season, at Cush, Co. Limerick, was completed and yielded further surprising results. It had been shown in 1934 that ring-forts with souterrains, characteristic monuments of Irish archæology, could be dated back to Late Bronze Age times by reason of cremation burials in urns having been found in one of them. Corroboration of this was obtained last year in the discovery that the fort which contained the burials was not the earliest of the series but had been built later than that adjoining it. It was further found that the site as a whole continued in occupation over a long period—bronze brooches dating from about 800 A.D. having been found. New house-sites were brought to light: some were of wattle-and-daub, and another with a compacted floor and post-holes was similar in plan to one discovered in 1934, and, while the individual features of the building are not clear, the discovery is important as showing the plan to be that of a distinctive Irish house-type.

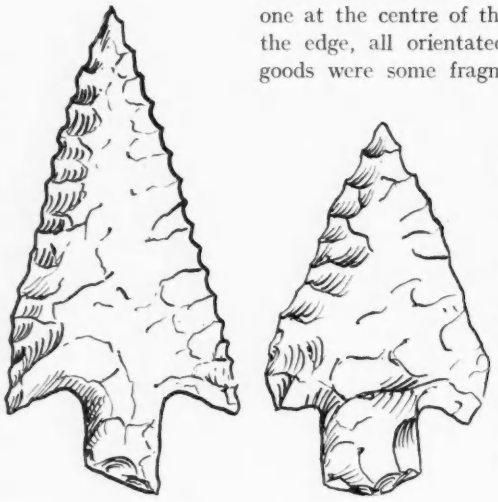
At Dunshaughlin, Co. Meath, work was continued on a *crannóg* (lake dwelling) which had already produced hundreds of finds—of glass, bone, wood, bronze, and iron—illustrating life in Early Christian Ireland (8th to 10th centuries). The second season's work showed the

crannóg to be of greater extent than previously imagined. The central house was located but only part of it has yet been uncovered. The enormous quantities of bones of domestic and wild animals which the site has yielded are an important feature of the excavation, and their identification throws light on the economic conditions of the period. Work is to be continued on the site during a third season. The monastic site of Gallen, Offaly, which had yielded already many important ornamented grave-slabs, proved less spectacular but continued to yield some further slabs as well as fragments to the number of about a hundred, all of which have been photographed and recorded and the publication of which will be an important step in tracing the evolution of Irish art. The site also afforded much opportunity for the study of physical anthropology, a large number of skeletons from the cemetery having been lifted, measured, and replaced.

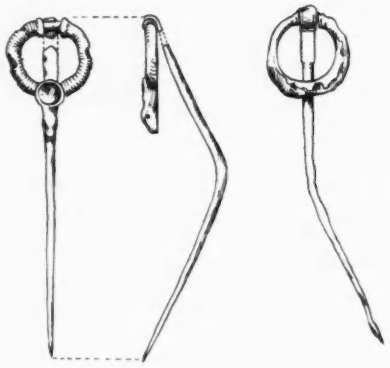
A large, low tumulus, largely destroyed by agricultural operations, and having as a core a cairn of stones, was completely examined at Lug, near Tullamore, Offaly. Cremated and inhumed burials, some unaccompanied by grave-goods and some having pottery of "food-vessel" type, were discovered. The tumulus is another example of the class of burial-mound with multiple interments which, from a well-known example published recently, may be referred to as "the Knockast type."

Two groups of small burial-mounds were also investigated. The first is a group of eleven tumuli of which three were excavated at Carrowjames, Co. Mayo. Each contained cremated burials—one covering two, the other three cremations. In each tumulus was found a small bronze knife or razor; in one case an urn accompanied the central burial, while in another some sherds of bronze age pottery were found. Objects of flint included scrapers, a barbed and tanged arrowhead, and chips. These tumuli are evidently part of a Late Bronze Age cemetery. Each mound has an over-all diameter (measured to the outside of the ditch) of about 45 feet, but a height of only about 16 inches to 2 feet.

The second group (of two burial-mounds) was examined at Pollacarragune, Co. Galway. One was *c.* 20 feet in diameter and *c.* 3 feet in height, the second 25 feet in diameter and about 6 feet in height. The smaller mound contained extended skeleton burials—one at the centre of the mound, the other three near the edge, all orientated N.W.-S.E. The only grave-goods were some fragmentary pieces of iron, one of which may be the remains of a shield boss. This cairn was evidently of Early Iron Age date. The larger, though better constructed, mound covered a cremated burial contained in a fine urn and accompanied by a beautiful, decorated tanged razor. While blades of oval type, usually with rivet holes but no tangs as found in the Carrowjames burials, may be regarded as either knives or razors, we must definitely place in the latter class such implements as that from the Pollacorragune tumulus. Such razors are already represented by about a dozen examples in the National Museum of Ireland, but that from last year's excavation is probably the finest known as regards excellence of decoration.



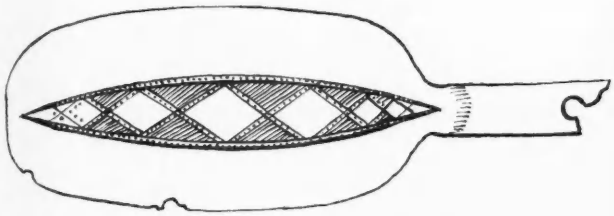
Finds from Cush, Co. Limerick: above, two flint arrow-heads (c. full size); below, bronze pins dating from about 800 A.D. (half size).



Three small and rather less successful excavations must now be mentioned to complete our brief survey. A dolmen at Ballyculane Upper, Co. Limerick, to which attention was drawn by the fact that school-children found a very fine stone axe under it, was excavated as part of the scheme, but no further finds were made nor could any trace of the burial be recovered. At Liathmore, Co. Tipperary, an ancient monastic site was investigated in the hope of learning something of the monastic buildings connected with the two churches still standing on the site. The result was, however, a blank and it seems probable that later buildings (only a few centuries in age), of which remains were found, must have destroyed the evidences of earlier structures.

The accidental finding and subsequent acquisition by the National Museum of a beautiful bronze pin from a fort near Oola, Co. Limerick, led to the excavation of the fort. This consists at present of a roughly circular platform about 80 feet in diameter and only two feet higher than the level of the surrounding country. Excavation produced many bones of animals used for food, including red deer, also a quern, iron fragments, a portion of a human jaw, a flint arrow-head, other flint fragments, and a bone marrow-scraper. There is no indication of occupation earlier than Early Iron Age times.

In general it must be said that the scheme of financing archæological excavations from a relief-of-unemployment grant has yielded excellent results over the two seasons. It has met with general approval in Ireland and with favourable comment from various sources in other countries. Archæologists will note with pleasure that the Government of Northern Ireland decided to some extent to adopt the same plan for the Six-County area.



Above: Bronze razor from a Late Bronze Age tomb at Pollacarragune, Co. Galway (full size). Right: Ornamented slab from the monastic site at Gallen, Offaly.

Contemporary Archives.

To speak of "contemporary archives" seems at first a contradiction in terms; but the increase in the *tempo* of modern events and the ephemeral nature of many of the reports concerning them call for the supply of some form of reasonably permanent record of events as soon as they take place. Such a record *Keesing's Contemporary Archives* claim to supply by means of a weekly diary of world events, with an index kept continually up to date. Without exhaustive research through the elaborate index it would be impossible to say whether this claim is made good absolutely; but for all reasonable purposes it is perfectly justified. By means of a loose-leaf system new data and new index-pages can be inserted in a binding-case as they are published; each new index incorporates the entries made in the previous one, thus replacing it entirely. Data (with their sources of origin) are furnished on a wide range of subjects, from Astronomy to Politics, and from Archæology to Aviation. Schools, colleges, and libraries should find this ingenious invention of the greatest value, and it must be well-nigh indispensable to the enterprising politician or journalist, and to anyone who would keep a finger on the pulse of the world's events. The yearly subscription rate is moderate and should be well repaid by the amount of information supplied.

The Amazon Revisited.

The seven-weeks tours to Portugal, Madeira, and the Amazon, organised by the Booth Line, lose none of their popularity, and not a few of the passengers, it is said, on the well-known cruising vessel, the *Hilary*, are making the trip a second time. So varied is the interest of the scenes passed by and of the numerous excursions which can be arranged, that it is all but impossible to appreciate them fully in a single voyage. The Amazon cruise, it should be noted, can be enjoyed by anyone in normal health; modern medical science has laid the ghost of disease which was once a continual menace in the Tropics of South America. The *Hilary* leaves Liverpool for the Amazon on April 9th, June 5th, and August 7th, and at intervals of two months thereafter.

Country Houses and The National Trust.

WITHIN recent years it has become increasingly recognised that the existence of many of the greater country houses of England is threatened. Social changes since the War, with the heavy increase of taxation and in particular of death duties, have chiefly brought this about; and there is no reason to suppose that the immediate future will improve these conditions. It is felt that unless some concerted efforts are soon made to relieve the owners of such houses within another generation or so, the nation will have suffered an irreparable loss in the disappearance of many specimens of unrivalled architectural interest, with their pictures, interior decoration, and period furniture. Up to a short time ago a similar state of affairs had long been a problem in France—where on the whole owners in the past have not been so willing as in this country to allow visitors to see their homes—for the existence of large châteaux in all parts of the country was threatened. But to meet this problem an organisation of château-owners, called *La Demeure Historique*, was founded about ten years ago by Dr. Carvallo. Already it has done a great deal to secure relief in various forms for the owners of very many châteaux in return for the opening of these châteaux to the public at a small charge.

Lord Lothian was the first person to consider a similar scheme for this country. In the summer of 1934 he directed the attention of the National Trust to the urgency of the problem and since then they have been considering what can best be done. In many ways the situation in England is different from that in France, but the threat to our country houses is no less real and the urgency for dissipating it no less pressing. The Trust have undertaken an attempt to solve the problem both by reason of the objects for which they were originally founded and because in future years they are likely to become the owners of a number of such houses bequeathed to them.

Amending the National Trust Act.

From the first it has been realised that, without enlisting the sympathy and active support of the Government, little can be achieved by the scheme contemplated. The National Trust, therefore, propose, if they can count upon sufficient support from the owners, to represent to the Government the need for certain amendments to the National Trust Act of 1907, and for other general legislation that may enable them the better to play their part in preserving as living homes the great country houses of England. Added to this, there will unavoidably arise the need for sundry legislation of a minor but often intricate character in order to remove restrictions, which in many cases would present difficulties to owners or life-tenants who wished to collaborate under the scheme. For this purpose the National Trust are elaborating a branch to be devoted solely to the Country House question.

The main work of this branch can be summed up under three headings. Firstly, it will endeavour to secure the regular opening of houses under the scheme and, by appropriate methods of propaganda to kindle greater interest in the public towards, and a greater appreciation of the houses concerned, which are, after all, perhaps one of the greatest heritages of this country. Secondly, it will press for various forms of relief to the owners. The chief of these would undoubtedly be an exemption from death duties of those houses incorporated in the scheme, so long as they were duly kept up with their contents and gardens according to their obligations under the Trust: again, funds made over to the National Trust for the upkeep of these houses, would also claim exemption from taxation: furthermore, local rating bodies would be solicited for exemption of the houses, wholely or in part. Thirdly, any surplus funds there may be will be put aside for exclusive expenditure on restoration and preservation work.

History and Architecture.

It has been suggested that this branch, or rather Association, shall have a membership consisting of one person (the owner, tenant-for-life, or trustee) in respect of each house in the scheme. The work of the Association is to be undertaken by a Managing Committee composed of nominees of the National Trust and other persons chosen by members of the Association under a Chairman appointed by the National Trust. This body's first duty will be to determine what houses the National Trust can consider, from an architectural or historical point of view, including in the scheme (subject, of course, to willingness on the part of the owners).

The important question, and of course the question on which the success of the scheme must ultimately depend, is that of giving the public access to these historic mansions, on the payment of a fee. A percentage of the fees would have to be remitted to the Association for guide books and propaganda associated with its aims. If the scheme meets with the success which is hoped for, the number of visitors must substantially increase year by year. Certainly the support which the National Trust have already received from owners in all parts of the country encourages them to believe that a final solution of this urgent problem is really in sight and that at least the more important of our country seats may be preserved for all time.

Intense Cold and Its Applications.

By Ruth Lang, Ph.D., A. Inst. P.

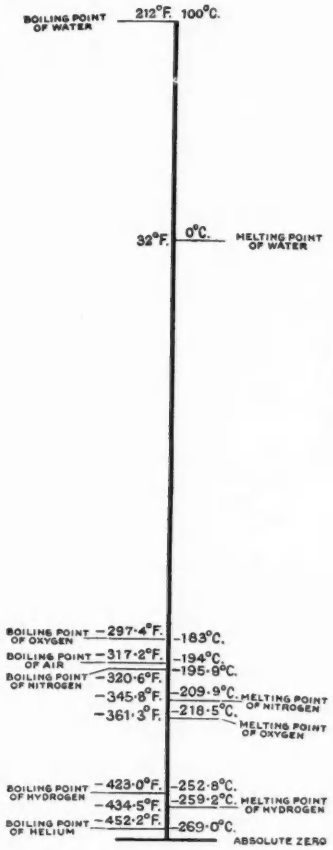
A special exhibition at the Science Museum in London has stimulated interest in the methods and problems of low-temperature research. Absolute zero cannot be reached, though it has been very nearly approached; yet the applications of very intense cold, especially industrially, still offer a fascinating field for discoveries.

EVERY known gas has now been liquefied and solidified and a temperature within two or three thousandths of a degree above the absolute zero has been reached. These are significant statements not only of the utmost importance to science but also to industry. Behind them lie excitement and disappointment, drama and pathos, of the kind experienced only by those who are fortunate enough to be pioneers in the search for knowledge; pioneers spurred on by that intangible urge that drives men to risk all in order to surpass some already wonderful achievement and set up new records.

The absolute zero of temperature is conceived as that temperature at which the thermal random motion of the molecules has completely ceased and its position is now accurately known to be —273.16°C. or —459.7°F. According to the concepts of physics it is impossible to reach such a temperature by man's experiments and although it has been so nearly approached it still is and always will remain an unattainable goal. As the gap between the lowest measured temperature and the absolute zero becomes smaller and smaller the experimental difficulties become increasingly greater.

In 1908 helium, the last gas to defy liquefaction, was liquefied by Kamerlingh Onnes in the famous cryogenic laboratory at Leiden at a temperature of about 4.2° above absolute zero, and eighteen years later it was solidified by Keesom in the same laboratory. Subsequent work has been concerned with devising more efficient and economical methods of producing low temperatures and investigations of the strange properties of substances at these temperatures. The work has yielded some surprising, interesting, and most important results.

Several methods are in use for the liquefaction and solidification of gases, which form the basis of all low temperature work. At present extreme cooling is a much more expensive process than heating, and it has been pointed out that to cool a body a certain amount at the temperature of liquid air costs about 500 times more than to heat the same body the same amount at ordinary temperatures. The older methods of producing extreme cold were of two main types; of these the first was due to Linde and Hampson, making use of the phenomenon (the Joule-Thomson effect) that if certain temperature conditions are fulfilled, forcing a gas through a throttle cools it, owing to the performance of "internal work" by the gas. The energy for this work is taken from the heat content of the gas itself which is thereby cooled. The second method, applied by Claude and Heylandt, forces the gas to do "external work" by means of reversible expansion, and again the energy is taken from the heat content of the gas which is therefore cooled. Among methods which have recently been developed may be mentioned Simon's "desorption" method, which is useful for producing small quantities of liquid helium suitable for laboratory experiments and has the great advantage of being simpler and cheaper than the older methods. Helium is brought into contact with activated charcoal cooled to a very low temperature by conduction from a bath of liquid hydrogen; it is then adsorbed in large quantities on the cold charcoal, which is then insulated and the adsorbed helium pumped off. By this process the heat of adsorption of the helium on the charcoal is removed and the latter becomes extremely cold indeed; so cold in fact that helium which is passed at a suitable pressure through a pipe surrounded by the charcoal, is condensed into the liquid form. A further



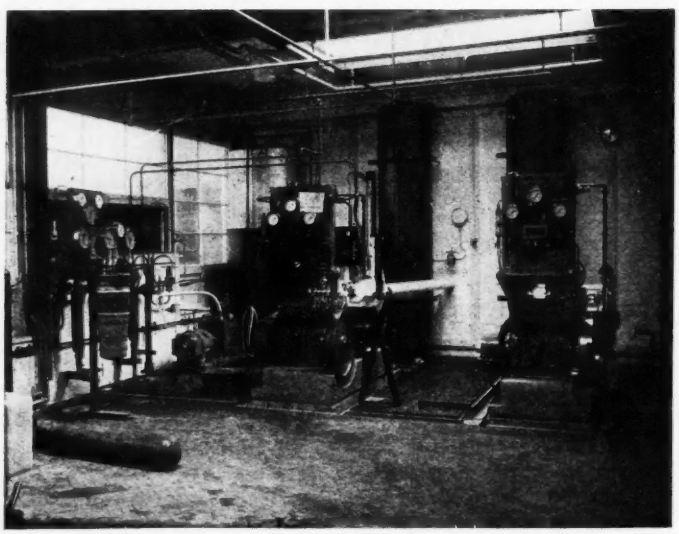
Some milestones in the approach towards the Absolute Zero.

method due to Simon and Mendelssohn, which has been employed in the Clarendon Laboratory at Oxford, makes use of the adiabatic or thermally insulated expansion of compressed helium gas. The middle Dewar or thermos vessel, as shown in the photograph opposite, contains liquid hydrogen in which the helium apparatus is immersed. This is first filled with compressed helium, which is then allowed to expand adiabatically (i.e., without loss of heat) with the result that liquid helium is produced. A factor of importance for the successful operation of this apparatus is that at these low temperatures the thermal capacity of the walls of the container is so small that they absorb a negligible amount of cold from the liquid helium. The temperature of the liquid helium is further lowered by reducing the pressure over it after it has been allowed to collect in the thin part of the Dewar vessel seen in the picture, thus causing a reduction in vapour pressure and a consequent drop in temperature. This technique is one commonly employed in producing low temperatures. The specific heats of substances at these low temperatures are extremely small and 50 cc. of liquid helium are said to be sufficient to cool down the whole system and to allow of five hours experimental work.

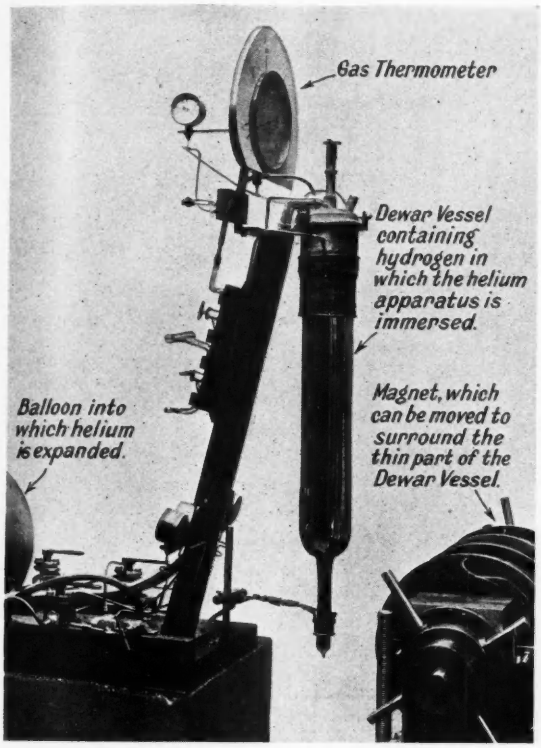
As opposed to the above two methods of producing liquid helium in small discontinuous quantities, a method for its continuous liquefaction has been developed by Kapitza, who has recently been recalled from Cambridge by the Soviet Union to carry on his scientific work in Moscow. It was designed with the primary object of high efficiency and the production of a large output with a small starting time. In practice the starting time was 75 minutes and the output two litres per hour although improvements on this performance are foreshadowed. The compressed helium is first pre-cooled by liquid nitrogen and the subsequent cooling is done in two stages—down to about 10° above the absolute zero by means of "external work" in an expansion engine, and subsequently by making use of the Joule-Thomson effect, which operates for helium only at low temperatures. Great ingenuity is required in overcoming the difficulties of lubrication at such low temperatures, and this engine is designed to work efficiently without any lubrication at all.

Still lower temperatures are reached by making use of the cooling effect of adiabatic demagnetisation of certain solids which exhibit the characteristic magnetic properties of paramagnetic substances—a method suggested by Debye and Giauque. The salt to be tested is cooled in liquid helium under low pressure in a very strong magnetic field, and is then thermally insulated. When the field is suddenly reduced the salt becomes demagnetised and in so doing is cooled. The lowest temperature yet recorded has been reached by this method and recently de Haas announced from Leiden that a temperature within 0.003° of the absolute zero had been reached.

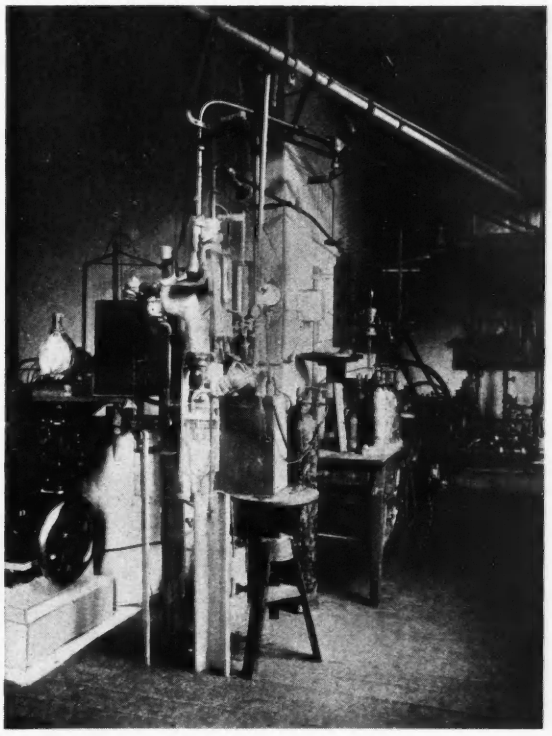
Though lately Britain has lagged behind other countries in low-temperature research, in the time of Dewar this country led the way. Indeed we are very much indebted to the early pioneers whose work was fraught with many dangers and difficulties. Lord Rayleigh recently related the following anecdote which well illustrates this point. "On one occasion," he said, "when I happened to be present I was struck with the iron nerve and composure of both professor (Dewar) and assistant. A, to me, alarming explosion rent the air of the laboratory, but Dewar did not move a muscle, or even turn to look. I asked in alarm what had happened; but it was only a good-sized vacuum flask full of liquid air which had smashed to atoms in the hand of his assistant Lennox. The incident was not thought worthy of a word of comment except in answer to a visitor! Dewar never admitted anything was dangerous. The most he would say was that it was a little tricky. Considering that Lennox and Heath, his two assistants, each lost an eye in the course of the



Liquid hydrogen installation at the Royal Society Mond Laboratory, Cambridge.
By courtesy of the Cambridge University Press.



Simon and Mendelssohn's Liquid Helium Apparatus.
[*By courtesy of the Royal Institution, London.*



The original Helium Liquefier. This photograph was taken at Leiden the day after the first liquefaction (July 10th, 1908).

work, this certainly was not an overstatement." Modern cryogenic laboratories are specially designed to minimise the possible danger due to the explosive nature of the substances involved. In the Royal Society Mond Laboratory at Cambridge, among other precautions taken, the liquid hydrogen and helium rooms have a very light wooden roof, allowing the force of an explosion to remove this rather than the walls, on the same principle as that used in the design of petrol and gas storage holders; if there is any appreciable leakage of hydrogen a number of automatic shutters are immediately brought into action.

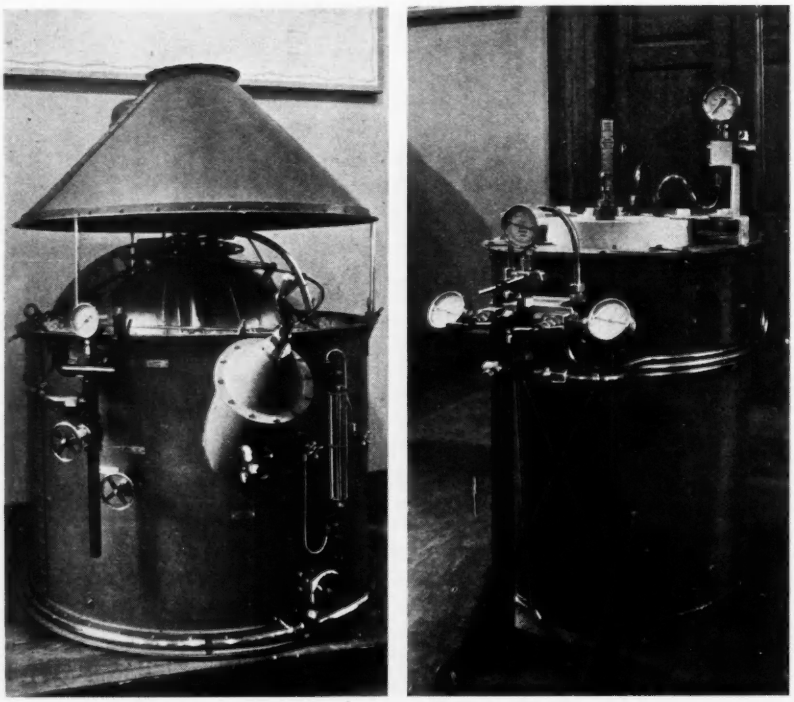
Space will allow only a brief reference to the difficulties of temperature measurement at this part of the scale. Electrical thermometers may be used to within about 20° of the absolute zero and gas or vapour thermometers to within about half a degree. Below this point, fortunately, a magnetic method of temperature measurement has recently been devised, depending upon the magnetic susceptibility of paramagnetic salts.

Among the most remarkable properties of substances at very low temperatures is that of supraconductivity which was first discovered by Kamerlingh Onnes. He found that when mercury was cooled to about 4.2° above the absolute zero, known as its transition temperature, its electrical resistance was reduced to zero and a current once started would remain flowing round and round the mercury with nothing to stop it. It is a much debated point whether this property would be a general property of all metals if the temperature were low enough; so far some sixteen elements have shown supraconductivity. The list, however, does not include copper or silver, two of the best conductors at ordinary temperatures. In addition to various binary alloys of two supraconductors, certain compounds of supraconductors and non-supraconductors, and even compounds of two non-supraconductors, have shown this curious property. These investigations are being prosecuted with great energy since the technique of the new magnetic method of producing temperatures within 1° of the absolute zero has been developed. The results are awaited with interest, especially in regard to the ferromagnetic metals.

Queer things happen to the physical properties of ordinary substances at liquid air temperatures. Rubber becomes hard and brittle; mercury solidifies to a hard metal; fruits become brittle and may be pulverised at

a blow; liquid oxygen is feebly magnetic and this property is shown also by nickel-copper alloys, which are non-magnetic at ordinary temperatures; and the tensile strength and ductility of metals change considerably.

The early workers in the low temperature field could hardly have envisaged, even in their wildest dreams, the enormous industrial applications, at present only in their infancy, that were to be the outcome of their researches. Liquid air, which is separated into its components by distillation processes, is the source of the rare gases argon, neon, krypton, and xenon which are extensively used in luminous advertisement signs. The beautiful colours are each characteristic of a different gas. Argon is used also for gas-filled incandescent lamps, and neon for neon lamps. Quantities of oxygen are liquefied annually and, after evaporation, used widely for oxy-acetylene metal cutting and welding, metal spraying, and various other metallurgical operations. It is also mixed with cotton for use as an explosive in quarries, is a valuable medical aid, and is used in various breathing and life-saving apparatus. After being liquefied it is stored in spherical copper containers, some four feet in diameter, surrounded by slag-wool or some such non-conducting material and an outer metal casing. These containers are transported on lorries to the consumer and the oxygen may be passed through an evaporator and the gas stored under pressure in large cylinders, or alternatively the liquid oxygen may be drawn off through a pipe not unlike an everyday petrol pump.



Liquid oxygen apparatus: on the left a container, on the right an evaporator in which the liquid is converted into a gas for industrial purposes.

Helium gas is used as a non-inflammable substitute for hydrogen in balloons and airships and, judging by the size of the new German Zeppelin, the LZ129, alone, there is a market for huge quantities of this gas. It is obtained from the gases given off by mineral springs and refined by fractionation at low temperatures. A minor use is as a breathing mixture, in conjunction with oxygen for deep-sea diving. Another low temperature industry that has grown up recently is that founded on the solidification of carbon dioxide, the various industrial applications of which were described by T. C. Crawhall in DISCOVERY in August, 1934. Liquid air is used in a great many experimental scientific laboratories, and especially in valve and lamp factories in association with charcoal for producing high vacua.

Readers interested in this romantic field of investigation may learn much by a visit to the special Exhibition of Very Low Temperatures, arranged at the Science Museum, South Kensington, London, which will remain open until May 31st. The fundamental theoretical principles underlying low temperature experimental technique are clearly demonstrated and the visitor is enabled to turn knobs, press buttons, and make things work for himself, special demonstration apparatus having been devised for this purpose. Here the visitor may see a liquid air plant actually in operation and demonstrations of the properties and uses of its products. All the chief methods of producing and measuring low temperatures are adequately represented. There is a unique and inspiring historical exhibit where may be seen many of the actual pieces of apparatus used by the early workers.

Sixty-Thousand Lakes.

By Elizabeth Harvey.

The beauty and ancient traditions of Finland, the "land of sixty-thousand lakes," are too little known among the English-speaking races. Here is a country of peace and quiet beauty, easy of access and cheap to live in, that well repays close acquaintance. Miss Harvey has an intimate knowledge of Finland, and her description, alike of its modern amenities and its ancient customs, is as vivid as it is attractive.

In the north of Europe there is a most attractive country: it offers delightful scenery, rich colour, pure invigorating air, the delights of novelty, and the thrill of discovery; æsthetic satisfaction is combined with modernist ideas and opportunities for sport are accompanied by an extremely low cost of living. Finland is an ancient country possessing a national epic which ranks as the fifth finest in the world, a national language and a national solidarity which six centuries of subjection to Sweden and one to Russia have merely strengthened. Upon the collapse of the Tsarist régime in 1917 Finland proclaimed her independence and civil war raged for the first three months of 1918, when, with the help of German troops, the communist element was suppressed.

Some of the sixty-thousand lakes: a typical Finnish scene of water and forest-land.

Many southerners miss a great deal by their hazy conceptions of this interesting and, indeed, startling country: startling because of its amenities, its cultural achievements, and its cheapness; interesting because of its unusual scenic formation, its customs and its history, past and in the making. Crossing from Sweden into Finland you notice at once that something colourful and eastern has been added to the bright, brisk cleanliness of the Scandinavian scene. Here the peasants are still peasants, characterised by a rough beauty and grace; they drive into the towns in little primitive carts to which are harnessed small brown horses with a gay, intelligent manner quite unknown to English horses. The women wear bright skirts and coloured headkerchiefs, the men high boots upcurling at the toe, and in the cafés they sit in statuesque dignity with the ease and stillness of perfect breeding, silent, sipping coffee which they pour from small copper kettles. Picturesque old women wash their linen beside the lakes, or tend solitary cows, and whole armies of them weed and cherish the grass slopes and avenues that beautify the towns, rake the gravel walks into intricate swirls and patterns, and keep the cobbles in a state of manicured perfection.

All the towns of Finland have their markets, but the Helsingfors market is one of the sights of the city. It lines two sides of the quay and is brilliant with flowers, fruits, vegetables, toys, wooden wares, dairy produce, and hand weavings. Beside magnificent flowers in pots there are bunches of wild flowers brought in together with a few eggs by old countrywomen; sometimes these old

women will sit nursing a solitary hen or duck, affectionately smoothing its feathers while awaiting its sale and slaughter. Farm-made bread of many shapes and colours is sold from little carts while the horses wait in long patient rows before bunches of hay. Much of the business is carried on from boats which crowd the edge of the quay, and methods of weighing are rough and primitive, scales being held in the hand and fish scooped up in a net like a sponge-bag. On the stroke of noon each day this busy scene dissolves as though by magic, and in a few minutes the quays are bare and spotless.

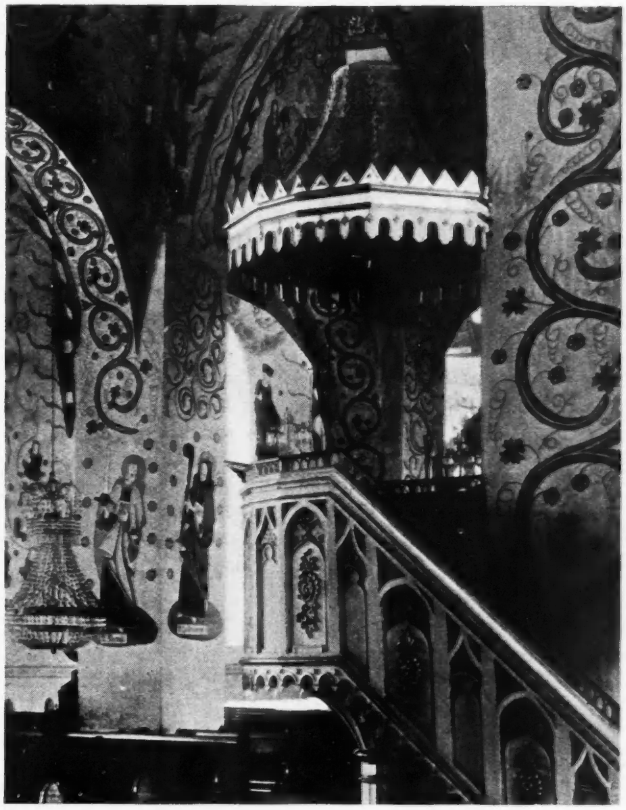
Helsingfors, or rather Helsinki as it is called by the Finns themselves, is a modern city with some very fine architecture; Turku, or Åbo, on the west coast, used to be the capital and has a few ancient buildings, including a beautiful cathedral, and a castle, now a superb museum. The sunsets of Helsinki are an elegant peach colour and do not concentrate in a single section of the horizon but spread impartially over the whole sky. For three months in the year sunset and dawn merge and in May the short hour or so of darkness only means that the dome of heaven is a deep electric blue. During these lovely nights, which Sillanpää, the great modern Finnish writer, speaks of as "a mere holding of the breath by the heavens while evening gives way to morning," all desire to sleep is lost, the air in some queer way acting as a substitute. The atmosphere of the city is immediately friendly and you never feel that sense of melancholic bewilderment which is apt to descend suddenly, especially at sunset, in a foreign town. And the same is true of the Finnish country as a whole; it is pleasing, welcoming, restful and compelling.

Finland is a large country, but the cultivated area is very small, the wealth of the nation being in the great virgin forests of pine, spruce, birch, and fir which cover the rocky surface of the land including those 80,000 islands which rest in the 60,000 lakes with which Finland is bejewelled. "Lakes and islands and islands and lakes" is the theme of the Finnish countryside, but there is infinite variety within this theme; the blue and silver of the water, the delicate silhouetting of the slender trees, the intoxicating light, make a soothing background for the mind. No two islands are alike and sometimes long ridges of land stretch out into the water; at Punkaharju a snake of wooded ridge, a road's width, extends for five miles with lovely views on either side, while beneath the trees grow mushrooms and wood flowers; yet on this natural pier you may well not meet another sightseer. A strange thing is that although Finland is so near Russia and was until 1917 a part of Russia, Russian melancholy is quite absent. The scene does not inspire it. Simplicity, content, and wisdom mark the Finnish attitude to life, and the presence of the sun is itself sufficient to inspire happiness; in the national epic, the Kalevala, the sun can bring the dead to life and this same feeling of direct contact with the elements persists. In Finnish literature it is strong and beautiful.

An ancient "grandmother" clock, now in the National Museum at Helsinki.

Finland is lucky in having for its chief industry one that involves such attractive materials and processes. In spring the rivers and lakes are in places solid with timber being floated to the ports. Also pulp and paper wood must be "floated" for a whole season and so thousands of logs are seen on the surface of the lakes penned into circles which in the distance look like huge floating islands of sand. Wood is everywhere, growing, floating, or stacked in many curious and decorative ways with a skill that compels admiration. Some is just piled in neat patterned heaps, some is built to weather in the shape of houses with roofs and window-openings and a maze of corridors, while the sawn planks destined for building and other purposes are so packed that they look like great cardboard boxes. The saw-mills are centres of activity and the owners usually have luxurious and beautiful houses, often solitary amid virgin scenery.

The railways of Finland are amongst the cheapest in Europe, since it is possible to travel 900 miles for one pound in third class, and 600 miles for the same sum in second class. Main roads in Finland are quite adequate for motoring and the Automobile Club of Finland is always willing to give advice and assistance. The great Arctic Highway, only recently opened, leading from Rovaniemi to Petsamo on the Arctic Ocean is a motoring route. For two months in the year the midnight sun is visible; good hotels have been placed at intervals on this route through the heart of Finnish Lapland, and even the non-motorist may enjoy the adventure, as a comfortable bus service has been established. More leisurely travellers, however, will take pleasure in



Old and new in Finnish art: on the right, the 15th century interior of the painted church at Lohja; on the left, the Three Blacksmiths, a work typical of recent sculpture in Helsinki, with a modern department-store behind.

the attractive white steamers which cross the lakes and link up the islands.

Although the peasants of Finland have kept their simplicity and the broad waters and forests their seclusion, Helsinki is a modern city where modern ideas have found their best expression. Except for the magnificent Senate Square, imposingly flanked by a great flight of granite steps leading up to the Nicolai Church, most of the buildings are new. The Diet House is probably one of the finest achievements of modern art in the world; it is of granite which has a faint pink tinge and its interior workmanship is as fine as its outer. Set on a peninsula and approached by a belt of islands the city has a charming natural position and its charms are increased by numerous trees, green boulevards and grass-covered spaces, as well as by the beautiful statues which are everywhere. Sculptures of animals, in particular, are amazingly well done by the Finns; the enormous granite railway station, with four massive peasant figures guarding the entrance is a majestic and arresting affair built by the famous architect Eliel Saarinen. Both in Helsinki and in the other large towns, hotels are modern and luxurious, and very reasonable; meals, which begin with the smörgåsbord, as in Sweden, are likewise excellent and cheap. Just outside the city on a beautiful island with natural bays and forest paths is an open-air museum where, in the pleasantest possible surroundings, one can study the past of the Finnish people:—the dark primitive houses, the farms, the long narrow "churchboats" which are still used in remote parts, an ancient wooden church, and the little hut in which the famous author Alexis Kivi lived his life in poverty. Beautifully placed too are the fortifications of Suomenlinna on their seven islands at the entrance to Helsinki; they were begun in 1748 and were once considered impregnable. On another charming island are the zoological gardens; on yet another is one of the people's recreation grounds with a crèche and theatre performances.

Finland offers so many interesting things to do and to see that many visits are essential to appreciate it fully. For those who like sport there is bathing, yachting, canoeing, and for adventurous people the thrill of shooting tumultuous rapids in the long, narrow

boats made for the purpose. This year the Finnish Ministry of Foreign Affairs has published a booklet in English called " Fishing in Finland " and this is full of all kinds of useful information and advice.

Sea and lake-waters abound in Finland so that bathing is inevitable. Terijoki in the East of Finland is a pleasant summer town with magnificent sands, and was formerly a favourite resort of the Russian royal family. For fishermen Finland is a paradise ; trout, salmon and grayling can be fished as well as pike, perch and many kinds of fish unknown in England.

Painted Churches.

Savonlinna has the oldest and best preserved castle in Northern Europe. Viipuri, too, has ancient buildings, and the unique painted churches, of which there are several in Finland, should not be missed on any account. The painted church at Lohja, two pleasant hours by bus from Helsinki, dates from the 15th century and is built of stone with a steep pitched roof, its belfry standing a little apart as is usual with Finnish churches. The whole of the plaster-work within the church is covered with mediæval paintings of biblical stories and unidentified legends ; animals of savage mien drink from cups through long tubes, and the garden of Eden scene and the picture of the Virgin clothing humanity are full of ingenuous charm. Hattula and Esbö also have painted churches and in East Bothnia there is a fine example of a wooden church in the Swedish manner.

The painted churches are inspiring but there is a group of buildings in Finland even rarer than they. Valamo is a Greek Orthodox monastery built on a group of exquisite islands, the largest about five square miles, in the middle of Lake Ladoga ; half this immense lake is in Russia and half in Finland and because, luckily, the monastery is just inside the boundary, it has been saved from destruction. Valamo is lovely at all times but on a feast day and when the trees are all in blossom in early June it is altogether indescribable. There are seven churches on the islands; the main one, Byzantine, stands magnificently with its tall belfry and five cupolas, its reds, blues, greens and gold brilliant against the white bulk of the main monastery buildings. Monks in their long black robes, tall hats, and long hair and beards will drive the visitor about the island or row him over the lake to visit the hermits who live for ever on their tiny islands. Guests are welcomed to Valamo with great courtesy and may stay in the Pilgrim's House for a very small charge. Several days are hardly enough to see all the sights ; two young American writers who went to Valamo for three days stayed three months.

A speciality of Finland which everyone who visits the country ought to try is the *Sauna*—the special steam-baths which Finnish people from time immemorial have been in the habit of taking once a week at least. When the peasants are building themselves a new house, the first thing they build is their little separate wooden bath-house ; it contains a great pile of rough stones and an upper wooden platform on which is a bench for reclining. The stones are heated and steam produced by throwing water on to them ; essential to the process is a thorough scrubbing from top to toe and a thorough beating with fresh young birch twigs, and the final stage is a swim in the cool lake water.

Besides its ancient institutions, its churches, its relics of Russia, its forests and islands, and its sixty-thousand lakes, Finland has produced some of the world's great men. The music of Sibelius is a perfect interpretation of the Finnish scene, the architecture of Saarinen is internationally famed ; Sillanpää will become a great name in literature, and the athlete Nurmi is an outstanding figure. Finns have excellent taste ; their antique *rugha* rugs are works of art, and their modern designs in furniture, fabrics, pottery, and porcelain are often beautiful, rivalling the best that are being produced in Europe.

Green Fingers.

(The following lines, reprinted from *My Garden* (March, 1936) are addressed in mild zoological protest to the author of *Green Fingers*. Mr. Priestland should know his subject, as the company with which he is connected is famed and feared in the aphis world.)

Now, Mr. Arkell, you're a poet,
It only needs your book to show it,
And so you must not think me mean,
But you depict on page nineteen
A Greenfly showing Sex Appeal,
While from your rose he takes his meal.
And, with a further shock, I read
Something about a " bridal bed."
May I submit, with all respects,
You're wrong about the greenfly's sex.

For through the summer there is none
Or else it's both rolled into one ;
In fact in language unpoetic
They call it parthenogenetic.
It's only when the autumn comes
That they develop " dads " and " mums,"
And eggs are laid, not living young,
From which the next year's brood is sprung.
I grant you licence as a poet
But thought perhaps you'd like to know it.

F. E. Priestland

(of Messrs. Cooper McDougall & Robertson, Ltd.)

The Riddle of the Chough.

By Leslie Major.

" F.Z.S." of the Western Morning News.

The chough has always been a bird of mystery. Here we present a serious study of its decline, and a theory which, while not claiming finality, at least is practical and invites discussion or criticism.

THE chough, as we know, is rather like a jackdaw, yet of the two birds the chough is by far the more interesting and attractive. Whether in character and disposition it is too sensitive and timid is a matter for conjecture.

To a greater extent than any bird—more so than even the robin—the chough has woven itself into the legends and folk-lore of Cornwall. As long ago as Queen Elizabeth's reign Camden, the naturalist and historian, wrote of the Cornish chough : " The inhabitants of the county find it to be an incendiary and to be fond of theft, for it has been known to steal pieces of money." This trait is common to the crow family, from the raven downwards.

Time was when the chough was quite common along the wild coastline from Land's End to St. David's Head. For years the stock dwindled, until it reached low numbers. At this, ornithologists began to sit up and take notice. So did the egg collectors ! I hold no brief and spare no words for the latter gentry. Let a species of bird begin to slip or show signs of serious decline, then the collector's lust, or his cupidity, is aroused. Struggling colonies are raided. Precious eggs, even young birds, are taken. The species is dying out ! The collector must have his specimens ! Yet the shame of it is that such people can pass as ornithologists and so gain information which otherwise would be difficult to secure.

For several years past Cornish ornithologists have done more than sit up and take notice of this tragedy of the chough. Its peculiar case has been studied ; theories for its decline have been advanced. Yet nothing which has been thought of or done has arrested the progress of the unfortunate bird along the road to extinction.

We know the chough to be gentle and highly intelligent. There is nothing particularly aggressive in its disposition. That it requires a great deal of " territory " is also known. On the other hand the jackdaw, while being intelligent, is sufficiently pushful to form new colonies, annex new territory, and greatly increase its status. Of late years a great deal of building development has occurred along the north coast of Cornwall. That the jackdaw, following humanity as always, has kept pace with this development cannot be gainsaid. So there may be some foundation for the theory that a great advance on the part of the jackdaw has helped the decline of the chough. Harried in its foragings, hustled on its breeding cliffs, the chough meekly accepted the superiority of the jackdaw.

The continued existence of the chough on the Cornish cliffs is threatened by disease, by in-breeding, and by the insatiable cupidity of the egg-collector.

At least one watcher of the chough believes the peregrine falcon to be the cause of the chough's decline. This man some time ago wrote me a letter so solidly denouncing the peregrine that, much as I should like to quote, I feel some passages would be regarded by ornithologists as rank heresy. Sufficient to say that the man concerned knows and loves the chough.

Being a cliff dweller and a coastline forager, the chough is peculiarly susceptible to the risks of rabbit gins laid openly along cliff-side burrows. Many choughs have succumbed to this hazard, which is an immense

pity. And so we have three theories, each of which is supported by undeniable facts, but that they do not point to the root of the trouble I am quite certain.

Perhaps, if we lump together the steady toll of gins, of falcons, and of jackdaw competition, we reach a stage of decline at which collectors' inroads could be sufficiently hurtful to represent the last straw. But does the jackdaw harry the chough? As a matter of fact, the two species seem to consort amicably together. What, then, is the reason for the passing of the chough?

Before dealing with this question, perhaps I should state that my opinions are based upon a knowledge of commercial poultry breeding, and of poultry diseases. Further than that, I have discussed the decline of the chough, in relation to two particular diseases, with more than one skilled poultry breeder. As their ideas coincide with my own I no longer hesitate to set out something which may, perhaps, be more than a theory.

The chough does not attain sexual maturity, and consequently does not breed before the second spring following its birth. With certain diseases, this is a much greater handicap than for a bird breeding in its "pullet" or first year. Further, when a colonising species like the chough gets low in numbers, in-breeding takes place, such in-breeding becoming "closer" in almost equal ratio to the decline. Close watch in Cornwall on family parties consisting of two adult choughs and their young, for a period of a year following the "bringing off" of the brood, indicates that a heavy proportion of young choughs die in their first year; many before the age of six months.

Dwindling Colonies.

A community may be observed, say, in September, apparently in good health. Through succeeding months that community will dwindle. Certain individuals drop out unaccountably, unseen, and with no indication of the why or wherefore. Then an individual is seen to be increasingly lame. Simultaneously one or two other birds show signs of dishevelled lack-lustre plumage—lustrous, tight plumage is always a sign of good health in a bird, wild or tame. This dishevelled appearance increases until the unfortunates concerned invite the description of "rag-bags" . . . the lame bird disappears . . . then, before another member falls lame, the dishevelled sufferers pass out.

This represents an accurate picture, I think, of the manner in which more than one colony of choughs has dwindled during the winter communal roost to half strength or less. At the call of spring, with the exercise of more open habits, it would be natural for at least one breeding pair to mate up from the survivors. Yet no! Old eyries remain untenanted, nor are new eyries started. This is truthful, tragic observation upon the life of the chough in recent years.

Like the clans on the Western Isles of Scotland, where what formerly was a hardy race has degenerated to a shadow of its one-time hardihood and physique thanks to emigration, in-breeding, and the scourge of tuberculosis, so has the stock of the choughs weakened on the cliffs of Cornwall. Tuberculosis can be hereditary among birds. At varying ages young birds from tubercular stock die off, and the symptoms are loss of lustre and pigment, loss of weight, a dishevelled appearance, anaemia and, quite often, lameness in conjunction with one or more of the foregoing. Yet I am not going to state definitely at this stage that tuberculosis, either alone or in conjunction with another disease, is the fell shadow that stalks the choughs of Cornwall.

The Scourge of Coccidiosis.

Coccidiosis and worm-infestation of the intestines are two maladies, neither of them hereditary, which are capable of results almost identical to those of tuberculosis. The scourge of worm-infestation hardly applies to wild birds—I think we may dismiss it straight away. A good deal of research work is still in progress with regard to coccidiosis, several forms of which have been shown to exist. Frequently rampant among such wild birds as starlings and rooks, it is acquired by infection through the mouth, being picked up in egg form. These eggs develop or hatch during the process of digestion, the parasites pass along to the walls of the intestines; diarrhœa stained with blood frequently is present. One highly interesting result of research applicable to the case of the chough has been the separation of the bird form of coccidiosis from the rabbit form. Rabbits are notoriously subject to ravages by coccidiosis; choughs feed and forage a great deal upon rabbit-infested cliffs; but we know now that there is no connection between the two forms of disease and that it is highly improbable that the rabbit form of coccidiosis would infect wild birds existing under natural conditions. So, as with worm-infestation, I dismiss coccidiosis.

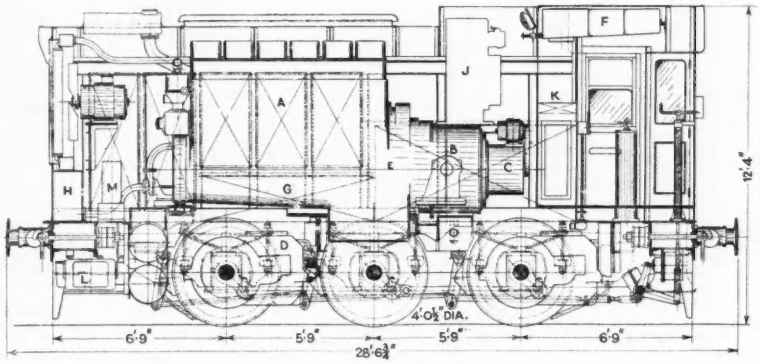
Of late years the poultry breeder has had to combat the most serious disease experienced during the history of the industry. That disease is paralysis; true fowl paralysis. The highest experts cannot state the cause, although here again research work is in progress which may yield valuable data at any moment. In some cases in-breeding is believed to be the cause. In others, blame is laid upon the severe egg-laying strain to which the modern hen, by reason of in-bred high fecundity, is subjected. Fowl paralysis is known to be hereditary and

(*Continued at the foot of the next page.*)

Diesel-Electric Engines.

SUPPLEMENTARY to the article on "Rail Transport Development" in our March issue, we are able, by courtesy of the Editor of the *Electrician*, to give our readers some particulars of an improved type of diesel-electric locomotive, a series of which is now under construction for the L.M.S. and for other railways of Britain, the Sudan, and South Africa.

These six-coupled shunting locomotives are rated at 300-350 h.p. The mechanical structure is made by Hawthorn, Leslie and Co., the well-known locomotive builders, and the diesel engines and electrical equipment are made by the English Electric Co. These locomotives meet all demands as an ideal shunting locomotive—maximum availability, economy in working, absence of stand-by losses, ease of operation and absence of noise, comfort of driver, and simplicity of inspection and maintenance. In regard to availability we learn that those in service at Crewe are being worked through the 24 hours with three shifts of drivers. They will carry a fortnight's supply of fuel, but in practice the tanks are normally replenished weekly. The locomotive gets away a heavy load with remarkably little effort and rapidly gains speed.



A, 350 h.p. diesel engine, 675 r.p.m.; B, 230 kW main generator; C, 11 kW auxiliary generator; D, 175 h.p. traction motors; E, oil fuel side tanks (400 gals. total capacity); F, oil fuel service tanks (100 gals. capacity); G, battery compartment; H, main water tank (70 gals. capacity); J, control frame; K, hotplate; L, compressor; M, water heater.

Elevation of English Electric-Hawthorn Leslie diesel-electric locomotive.

The diesel engine is started electrically, and the push-button control for this purpose is mounted in the cab adjacent to the driving positions. The engine is of the solid-injection, cold-starting type, and even under the worst climatic conditions it can be started in a few seconds. The engine can be shut down immediately there is a check in the shunting.

The diesel-electric unit is easy to handle, control of the locomotive being centred in two small levers, a speed-control lever and a reversing lever. The locomotive responds instantly to a movement of the control levers; reversing can be effected immediately, since there is no need to take up a number of turns as is necessary on the reversing gear of many steam locomotives. A straight air-brake or vacuum brake is provided as may be required, together with a screw-down hand-brake operating on all wheels. The compressor, or vacuum pump, has an independent motor drive, and in the event of a shut-down of the power unit, an alternative supply is available from the storage battery. The driver's cab is heated by means of circulating hot water (under his control), and an electric hotplate is provided for warming the driver's food.

The original type-locomotive has been operating on L.M.S. lines since 1934, and has now completed 6,000 hours of regular shunting duties of almost every kind. It has been able to perform all the duties without difficulty, and has proved superior to the steam locomotive in availability and efficiency of operation.

(*Continued from the previous page.*)

but very slightly infectious. Beyond the fact that no cure exists at present we can say little.

From my personal knowledge of fowl-paralysis which, fortunately, is not extensive, it seems worthy of record that the lameness in an overwhelming percentage of cases occurs with the right limb, generally below the thigh, along the tarsus. A similar loss of weight and condition occurs as with tuberculosis. The manner in which paralysis claims its bird victims at the age of five months and onwards is strikingly similar to the case of the chough.

How can a theory of fowl paralysis be applied to the chough, a wild bird? Personally, I am confident that the malady—if malady there be, which seems definite—is either tuberculosis alone, or a form of paralysis which has settled in degenerate stock brought to a low level of physical health by hereditary tuberculosis. Further, were a typical specimen of a deceased chough submitted to a Physiological Research Laboratory, I believe that the resultant report would confirm my statements.

The Light and Sound Analogy.

By Mary Barne.

Scientists since Newton have drawn the analogy between the sensations of light and of sound. The accurate measurement of the wave-lengths of coloured light now attainable reveals this analogy to be closer than perhaps was suspected. With the advent of electrically produced music, this should afford scope for further research.

THE analogy between light and sound—and especially its æsthetic aspect, known as "colour-music"—has exercised many minds. Sometimes the subject has been treated in a semi-mystical manner; but, oftener, more or less scientifically.

The Greeks loved similes and analogies. The quarter-tones (demi-semi-tones) that they recognised in music, they called "colourings." Aristotle speaks of harmony among colours, and compares it to musical harmony. "Colours, and musical sounds," he writes, "should be mutually proportionate."

Newton was, so far as we know, the first to think out these vibrational analogies. He constructed a colour-scale based on the respective *lengths* of the colours in the solar spectrum, and compared (as many have done later) the seven principal colours with the seven notes of the musical scale; but he placed his colours in the reverse order to that in which, vibrationally, they should have been, making violet the lowest note instead of the highest. The following quotations from his *Optics*, however, showed that he came to realise that the analogy rests on a vibrational basis: "As Sound in a bell or musical string, or other sounding body, is nothing but a trembling motion, and in the air nothing but that motion propagated from the object . . . so colours in the object are nothing but a disposition to reflect this or that sort of rays more copiously than the rest." In another place he asks: "Do not several sorts of rays make vibrations of several bignesses, which, according to their bignesses, excite sensation of several colours, much after the manner that the vibrations of the air, according to their several bignesses, excite vibrations of several sounds?" Also: "May not the harmony and discord of colours arise from the proportions of the vibrations propagated through the fibres of the optic nerves into the brain, as the harmony and discord of sounds arise from the proportions of the vibrations of the air?"

The Helmholtz Scale.

During the 18th and 19th centuries, there were several writers on the analogy, but none of scientific distinction except Dr. Thomas Young (who first suggested the trichromatic theory of colour-vision), and the great Helmholtz. The latter formulated a colour-scale, in the proper order, and extending about a "fourth" beyond the musical octave. At the beginning of our century, Dr. Wallace Rimington, Fine Arts Professor at Queen's College, London, was struck by the analogies and wrote a highly interesting book on *Colour-Music*, in which he described an instrument that he invented for the display of mobile colours on a screen. At present, Mr. Tudor Hart, Professor C. K. Ogden, Mr. James Wood, and Mrs. Sargant Florence, are the principal exponents of various light-and-sound similarities.

Physical Analogies.

The principal facts on which the theory (in its most usual and—the present writer thinks—most reasonable form) rests, are as follows:

(*A*) Physical: Musical sounds are produced by air-waves of regular vibrationary periods. Colour, also, is produced by regular vibrations, but of an electro-magnetic nature. It appears that white, or neutral grey (achromatic) light must consist of irregular motions, for Lord Rayleigh wrote: "Previous to resolution, a curve representative of white light would show no sequence of similar waves." Next, a musical note can vary in three ways only; these three variables are:—

Pitch, which depends on the wave-length (varying inversely, of course, as the frequency).

Intensity, or loudness, which is governed by the wave's amplitude and, sometimes, by the quantity of air moved as well.

The third variable—quality or *Timbre*—varies with the form of the wave. Now the forms of sound-waves are infinitely varied, owing to the complexity of their constitution in all except a very few cases. This complexity is due to the fact that all sound-waves (except those from a flute, closed organ-pipe, etc.) are composed of many combined vibrations, whose composition follows Fourier's law, viz.: Every form of wave can (unless itself simple) be produced by the addition of simple vibrations whose frequencies are once, twice, thrice, four times, etc., as great as the frequencies of the given motion. Therefore, the notes heard by a practised ear, sounding with, or immediately after, the "prime" or fundamental note, are of shorter wave-length ("higher") than that note, and run in a regular series. They are termed its upper partials; and on

their number, order, and relative intensity, depends the quality of any musical note.

And a " colour-patch " also can vary in three ways only :—

Hue—which depends on wave-length.

Luminosity, or intensity of light—a measurable quantity—depends on the wave's amplitude, and also, to a small extent, on the amount of light employed.

Saturation, or strength, depends on admixture of, or freedom from, white light. Therefore, like timbre in music, it is concerned with the simplicity, or complexity, of its constituent wave-form—which, again, is determined, according to Fourier's theorem, by its mode of vibration (the manner in which it moves)—and this, again, by the simple " trains of waves " of which (if not itself simple) it is composed. In Lord Rayleigh's words : " By Fourier's theorem, any arbitrary disturbance may be so compounded." An admixture of white light with the rays reflected from a coloured—say a blue—object means, of course, that rays from other parts of the spectrum are mixed with the blue rays ; you get thus, not only a paler, but a less pure blue—in point of fact, pale blue inclines towards violet, and pale red (pink) towards lilac or mauve.

Physiological Analogies.

(*B*) Physiological : " In the vestibule and ampullæ of the ear are nervous terminations, the sensations aroused in connection with which are cognised in the auditory centre as noises." I quote from Helmholtz. These sensations are, of course, those produced by *irregular* vibrations.

Again I quote Helmholtz : " In the deepest recesses af the labyrinth is the cochlea, on whose walls are an immense number of small bodies, Corti's arches, each of which vibrates under the influence of a regular undulation whose period coincides with its own." (There are, it is now supposed, about 3,000 of these minute organs.)

Now, in the retina of the eye, immediately above the visual cells, lie numerous structures, the " rods and cones," the specialised receiving organs for all sensations of light ; and, founding her suggestion on a theory originated by van Kries, Dr. Ladd-Franklin, lecturer in Columbia University, supposes that " the rods contain the undeveloped molecules which give us the sensation of grey only, while the cones contain the colour molecules, which cause sensations of grey and of colour both." She gives many reasons, of a highly interesting nature, for her supposition—space forbids their description here. Further, she writes : " If this distribution of functions of retinal elements is a correct one, then the structure of the eye offers in this respect a perfect analogy with that of the ear." Also in the eye as in the ear, resonance exists. The nerve endings at the base of the retina are, according to Young and Helmholtz, of three different kinds, each tuned to one of the three fundamental colours : red, green, and blue-violet (Hering adds a fourth : yellow) ; these are equally distributed about the base of the retina. All other colours are produced by the joint stimulation of two (or three according to Hering) of these " resonators."

Psychological Analogies.

(*C*) Psychological : This aspect deals chiefly with the question of harmony.

Almost all supporters of the analogy have followed Newton in comparing the seven principal spectral colours with the seven notes of the musical scale. But it should be remembered that these notes are taken quite arbitrarily, and for convenience's sake, from the 3,000 frequencies to which Corti's organs are tuned. Later analogists or " colour-musicians " have compared the twelve equal semitones of the scale with a colour-scale that includes the non-spectral hues (formed by mixtures of red and blue). Taking a point near the " B line " (6869 Å) in the deep, not too dark, red of the spectrum, also taking C natural as " tonic," and setting down the colours obtained by the ratios of the musical scale, we get the following :—

Notes.	Hues.	Wave-lengths (Å)	Ratios.
C	= red	6900	1
C sharp	= red-orange	6468	16 : 15
D	= orange	6133	9 : 8
D sharp	= greenish-yellow	5750	6 : 5
E	= warm green	5520	5 : 4
F	= emerald green	5157	4 : 3
F sharp	= peacock blue	4968	25 : 18 (the tritone)
G	= blue	4600	3 : 2
G sharp	= blue-violet*	4313	8 : 5
A	= violet	4140	5 : 3
A sharp	= purple	3881 (non-spectral)	16 : 9
B	= purple-red, " magenta "	3680 (non-spectral)	15 : 8

The twelve hues are best imagined as a circle, so that after " magenta " one comes round again to red, forming the octave ; and this colour-scale can, of course, be constructed with any of these twelve hues as tonic.

Thus it appears that the concordant hues—like the musical concords—bear the *simplest* ratios to one another. The colour-scale shows where these may be found ; that is its use. Everyone knows that two reds (for instance) " kill " each other, and that red and

*Wrongly called " indigo " (a greenish dye) by Newton and others

magenta do the same. But the colour-scale also shows that a colour and its complementary should not be juxtaposed, for their ratio is the most complex of any. This latter fact is intimately connected with one of the analogy's two most interesting points. These are :—

(1) The " tritone," a 2-note chord with an interval of 6 semi-tones, is so harsh a discord as not to appear in any ordinary list of intervals within the octave. It used to be known as " *diabolus in musica.*" From the point of view of melody, it may be noted that the two notes composing it do not both appear in any, even pentatonic, scale. Compare all this with the harsh effect of juxtaposing two complementary colours—and the fact that the complementary ratios all closely approximate to that of the tritone, namely 25 : 18.

(2) Lights of any three hues equidistant (vibrationally) from each other form white when mixed on a screen—as do those of any two complementaries. And it will be found that three equidistant *juxtaposed* hues have the same unpleasant effect as has a pair of complementaries. Now, of the six consonant triads of any musical scale, not one consists of three equidistant notes.

The analogy must not be pressed too far ; but these two points are curious and interesting, and worth further study.

Vermin Destruction with HCN.

By C. R. A. Martin.

Hydrogen cyanide, or HCN, is the material most generally used nowadays for disinfestation. Though its properties have been known for many years, its use for cleaning up old dwellings is a development of the great housing schemes of to-day ; and there is yet room, as will be seen, for investigation regarding the effectual control of this practice.

THE public attention that has recently been given to bugs and their prevalence in working-class houses, although indicative of a general awakening of the public conscience to the gravity of our housing evils, is primarily due to the vast rehousing schemes which local authorities are carrying out in connection with slum clearance, and to the fact that it is being found exceedingly difficult to transplant slum denizens into new houses and flats, minus their vermin. Bugs may be in the news, so to speak, but they are by no means new. They have existed in the working-class areas of London and other big cities, in seaports and dockside districts especially, for centuries ; in many slum areas, indeed, it is rare to find a house free of them.

They are little brown insects, not more than one-quarter inch in diameter when full grown ; thin and flat and capable of entering the smallest cracks and crevices. Not particularly quick of movement, they possess protective stink glands, which give to a room badly infested with them a characteristic odour, sometimes likened to the smell of perspiring feet. Their principal places of refuge are in mattresses, especially defective straw ones, in the woodwork and inaccessible parts of coil spring mattresses, in the joints of wood and iron bedsteads, behind skirtings, sills, mantels, architraves, joists, rafters and other woodwork, under wallpapers, in the cracks of plastered walls and ceilings, in upholstered furniture, etc. Here the females deposit their eggs, which are capable of resisting extremely unfavourable conditions. Bugs appear to possess a curious homing instinct ; they suck their fill of blood during the night and at daybreak may be seen wending their way homeward, back to the dusty corner, the crack or crevice, which first gave them shelter. Badly infested houses teem with vermin in the heat of mid-summer. Sleep is impossible, and with their rotten woodwork and walls, and an abundance of breeding places, it does not indicate want of effort to label as hopeless the task of thoroughly disinfesting slum property.

The method which is being generally adopted to ensure that slum-dwellers and their belongings enter new houses and flats free of vermin (even if they do not remain so for long) is to treat all furniture with hydrogen cyanide (HCN), sometimes called hydrocyanic acid gas or prussic acid gas, either in a special chamber or in an airtight furniture van kept for the purpose. Then the people who are to be moved all go to a cleansing station, where their clothes are disinfected with superheated steam and they themselves cleansed and deloused if

necessary. After being subjected to this process, people and furniture go to the new homes.

The disinfestation of structurally sound houses, where tenants must perforce remain and live, is a more difficult task, and since systematic re-conditioning of working-class houses throughout the country, to proceed side by side with slum clearance, is one of the main objectives of present housing legislation, the elimination of bugs obviously forms part of the routine procedure ; it must, in fact, take place before any re-conditioning is begun.

In the last few years, there has been much research into the efficacy of various fumigants and vapour sprays for bug destruction and it is now universally agreed that the quickest and most certain method is fumigation with HCN. This gas, generated in one of several ways, is slightly lighter than air and possesses remarkable penetrative ability. It will most certainly destroy all bugs and their eggs in a space of about six hours, with a normal concentration, *i.e.*, 1-2 volumes per cent. With most other fumigants repeated fumigation is necessary, which, in occupied dwelling houses, raises obvious difficulties. The failure of ordinary fumigants at the first application was always believed to be due to a specially high resistance of the ova of bugs, but recent experimental research has shown that this is not so ; eggs are not so difficult to kill as the adult bug, especially the bug that has not fed for a lengthy period.

High Toxicity.

The great advantage of HCN then is that it is effective in one short application ; furthermore, it has no injurious effect on fabrics, metals, etc. Its great disadvantage, however, is its high toxicity to human beings. Houses must be vacated for at least twenty-four hours and, if a solitary house in a terrace is being treated, those on either side for about twelve hours. The actual work of fumigation is carried out in the usual way : all openings to the external air are sealed, except the back or front door by which the operators (there should be at least two) expect to leave ; wainscotings, skirtings, panelling, poilite sheets, etc., are loosened to allow entry of the gas ; cupboards and drawers are opened ; mattresses, bedding, and clothes spread about ; then operators in gas-masks place materials for generating HCN in suitable positions to secure the maximum diffusion. Specially prepared test-tubes containing live bugs are generally placed under mattresses, etc., in each room to test the efficacy of the fumigation. The last exit is sealed as the operators leave and the house left for about six hours, after which it is opened and thoroughly aired, various tests being made for the presence of residual gas, regarding the value of which more will be said later.

The methods employed for the generation of HCN vary. It may be used either in the dry form, *e.g.*, some inert porous material saturated with HCN liquid or calcium cyanide dust, or tablets containing 25 to 50 per cent. HCN, or else as liquid poured or sprayed over the floors or placed about in trays, or by treating sodium or potassium cyanide with sulphuric acid. The first method is the one principally used. To obtain the best results it is essential that the rooms of any building to be fumigated should be dry and warm. HCN is liquid up to 78 deg. F., and becomes a gas only above this temperature. The warmth also ensures that bugs are exhibiting their usual summer liveliness ; at temperatures below 60 deg. F. they breathe so slightly that they do not absorb a toxic dose of gas. In cold weather, therefore, it is necessary to raise the temperature of the building by burning coke or charcoal fires before HCN is liberated.

Although HCN is such a highly poisonous gas, it can be used with safety in the hands of experts exercising the greatest care, but when used by unskilled or insufficiently trained men, it is extremely dangerous, and fatal accidents are likely to occur. Disinfestation of houses by HCN is, therefore, usually carried out on behalf of local sanitary authorities by specialist firms.

Danger of Residual Gas.

The principal danger to human beings does not appear to be during the actual work of fumigation, however, but owing to the presence of residual gas in fumigated dwellings and furniture and to the inadequacy of existing methods of testing for this. A recent catastrophe at Aldershot very forcibly advertised the danger of using this gas for vermin disinfestation in occupied dwelling houses. In this case, several houses, the tenants of which had been provided with temporary accommodation elsewhere, had been treated with HCN by a specialist firm, and had apparently been thoroughly ventilated and subjected to tests for residual gas before the families were re-admitted. Then, in the middle of the night, one of the tenants awoke to find two of his children asphyxiated and others affected by the inhalation of gas. I have no knowledge of the nature of the tests made when the houses were opened after fumigation, nor whether the actual location of the residual gas which caused the fatalities was ever discovered (it did not appear to have been, according to the newspaper reports of the inquests), but it seems obvious that gas must have been enclosed in the mattresses or pillows upon which the children slept—a fatally striking instance of the special danger of HCN.

Buildings can be cleared by opening them for thorough ventilation for several hours (a Ministry of Health circular recommends a minimum ventilation period of 24 hours and a much longer one in cold weather). Masked

operators test for pockets of HCN (which incidentally has little or no smell), in passages, stairways, cellars, behind panelling, etc., by exposing strips of filter paper moistened by a freshly prepared solution of copper-benzidene-acetate. The papers will turn blue in a few seconds if HCN is present to the extent of 1 part in 10,000. To assist in the detection of gas, some specially prepared forms of HCN contain tear gas. Whilst fabrics, clothes, etc., may be similarly tested, it is impossible to ascertain whether any gas remains in the interior of thick heavy articles such as feather and horse-hair mattresses, flock mattresses, upholstered furniture, etc. The usual practice is to beat them thoroughly to drive off the gas, but undoubtedly this is insufficient, particularly in the case of mattresses and bedding which may contain moisture, such as from repeated soiling with children's urine, a not uncommon condition of bedding from the homes of the poor. When such a mattress is slept upon after HCN treatment, the warmth of the body is sufficient to vaporise the moisture and release the gas, which is inhaled by the sleepers.

In consequence of the Aldershot fatalities, it was hoped that the Ministry of Health would frame regulations specifying the precautionary measures to be taken in vermin disinfestation of dwelling houses by HCN, but nothing except the circular letter to local authorities above referred to has yet come to hand. In this, it is recommended that no dwelling-house should be allowed to be re-occupied until a written certificate has been given by the responsible operator that the premises have been properly tested and are free of gas, but the difficulty is not so much in the house, as with the contents of the premises. HCN has been in universal use for many years in flour mills, ships, warehouses, granaries, dock buildings, to say nothing of rat-infested refuse dumps, and it was only when it began to be used in dwelling-houses containing furniture that its dangers became appreciated.

The only safe Method.

The Ministry of Health recommends that bedding should be treated in steam disinfectors where practicable, but in the large slum clearance schemes of the industrial areas, this course will not be possible, as steam disinfecting plants are generally fully occupied with ordinary infectious disease work, and could not cope with verminous bedding, assuming that it were wise to adopt this course. So that the only safe method of treating bedding, clothing, carpets, and every other article which may retain gas in its texture, is to remove them from the house and treat them separately, either in special disinfesting chambers or vehicles, where the dosage of gas can be increased and the exposure reduced to one or two hours, with facilities for repeated heating, forced draughts of hot air, etc., for removing all traces of residual gas. And as it is evident that vermin disinfestation is to become an obligation of local authorities, just as disinfection after infectious disease is, there should be greater research into this highly important and dangerous work.

Correspondence.

THE FUTURE OF BRITISH INSECTS.

To the Editor of DISCOVERY.

Sir,—We feel that the article by Mr. Eric Hardy, which appeared in the February number of DISCOVERY calls for some comment. Our impression is that while on the economic side of entomology Mr. Hardy is fully informed, on other aspects of the science he makes statements which are definitely in error. It would appear that in an attempt to be brief, Mr. Hardy is often led into stating half-truths and minor inaccuracies, which although perhaps not definitely wrong, are apt to be misleading. It is exceedingly difficult for one man to be an authority on all aspects of a subject with so wide a range as entomology, but when there are so many entomologists available with special knowledge and quite willing to impart it if consulted, it is a pity that inaccuracies should find their way into print.

We append a note of a few of the matters on which we do not quite agree with Mr. Hardy, omitting one or two errors which are merely a question of the mis-spelling of names.

P. 41, par. 1.—Although potential insect pests do arrive fairly frequently in imported produce, etc., it is fortunately a decided exaggeration to state that " many of these " have anything to do with " changes taking place amongst the numerous insects . . . of town and country." The number of species of insect that can be called pests in this country is insignificant compared with the total of other species, and their behaviour hardly provides a suitable yardstick. Far more interesting are the changes in the species which cannot claim any right to be called pests.

Par. 2.—It is a moot point whether the Camberwell Beauty was ever more than a rare visitor. Determined attempts to establish it in Great Britain have always met with failure. It has never before been suggested that the Large Tortoiseshell was confined to East Anglia. It is generally distributed in the S. of England, but always rare. The Large Copper never occurred in Devon. It was confined to the Fen country and has been extinct there since about 1845. The planting of pine woods is much more likely to decrease the number of Skippers than to increase it, as the caterpillars of most of our species feed on grasses, which very seldom grow well in pine woods.

Par. 3.—It is considered very doubtful whether the Field Cricket was ever " common and familiar." The evidence all tends in the opposite direction. It may at times be *locally* common (*e.g.*, as in Gilbert White's field) but never *generally* common. If the House Cricket is commoner in the north than the south, it must be very common indeed there. Most of the

recorded plagues (associated with refuse dumps) that we can recollect have occurred in the south. It may be commoner *indoors* in the north than the south, but this is a doubtful measure of its real numbers, and hardly a safe indication of the rate of disappearance of kitchen ranges!

Par. 4.—The Colorado Beetle may have occurred at Liverpool, but we have no note of it there.

P. 42, par. 5.—It is considered very unlikely that camping would normally have any considerable effect upon a mosquito population—but we are not acquainted with the Wirral peninsula.

Par. 6.—*Hylotrupes bajulus* is not causing any more concern now than during the past 15-25 years; but it has received more publicity lately in the press.

Par. 7.—The Cherry Fruit Fly has long been on the Ministry of Agriculture's List. Available evidence suggests the species may be unable to survive the English climate. The credit for the introduction of the Derris treatment against Warble is surely due to the Ministry of Agriculture Committee in the first instance.

Par. 8.—Not only is the fresh water fauna reduced by pollution, but all over the country it is now being affected by the partial and regular drying of large areas of river beds through the withdrawal of quantities of water for industrial and public purposes. This results in the entire destruction of all subaqueous life in the portions of the river beds exposed and dried by these artificial droughts. When the water is restored the diminished insect life redistributes itself only to be once more wiped out when the next drought occurs. This system results in the establishment of regular artificial droughts in place of the occasional natural droughts, and its effect is cumulative.

The absence of criticism of the remainder of the article is not to be taken as a tacit admission of its correctness. It has not been submitted to detailed examination.

Yours faithfully,
SOME OTHER ENTOMOLOGISTS.

THE BRITISH SPELEOLOGICAL ASSOCIATION.

To the Editor of DISCOVERY.

Sir,—This Association was recently formed under the Presidency of Sir Arthur Keith, F.R.S., with the objects of co-ordinating the results of cave excavations and explorations in this country, and of acting as a central bureau from which information pertaining to all aspects of speleology might be distributed and through which those interested in cave work might become acquainted with others of similar or kindred interests.

At the present time the Association is preparing for publication a bibliography of papers on British Speleology, and a catalogue of all prehistoric artefacts which have been excavated from the caves of this country and which are now scattered throughout various public and private museums. Steps are also being taken to organise a survey of the more important underground rivers and streams with a view to assisting the Inland Water Survey Committee of the Ministry of Health. An investigation into the relative advantages of gravitational and electrical geophysical methods for detecting caves is also being undertaken.

These and other objectives are to be carried out by the various associated Societies, Clubs, Museums, Libraries, etc., and by the individual members of the Association.

One of the most important functions of the Association is the organisation, each year, of a Speleological Conference. Through the kind hospitality of the Mayor and Corporation the Conference is to be held this year at Buxton, from Friday, July 24th, to Monday, July 27th, inclusive. The Conference, attendance at which is free to members of the Association, will also be open on payment of five shillings to all persons interested in speleology.

Societies, Clubs, Museums, Libraries and similar bodies, on payment of one guinea become associated Institutions and may appoint two representatives who will enjoy all the privileges of ordinary membership. On payment of half a guinea per annum or five guineas, any person may become an Ordinary Member or a Life Member respectively.

Further particulars of the Association and of the Buxton Conference may be obtained from the Honorary Secretary and Treasurer, Mr. G. H. Hill, The Museum, Buxton. Mr. E. Simpson of Austwick, Lancaster, is the Honorary Recorder of the Association and to him should be forwarded all technical matters pertaining to the exploration and excavation of caves.

Yours faithfully,
L. S. PALMER,
Chairman of Council.

University College, Hull.

MIRAGE ON ROADS.

To the Editor of DISCOVERY.

Sir,—Since this question was first discussed in DISCOVERY I have been keeping a special look-out for mirage effects on our tar-macadam streets and roads, where they are very common in warm weather. I have seen them at various hours of the day and on various road slopes with various backgrounds.

I have seen them during afternoon hours this January, while travelling E., N., W., and S. When a pedestrian or vehicle approached from, or went away beyond a given point, a reflected image (sometimes quite recognisable) could be seen in the patch of mirage.

Thus I have seen an approaching cyclist, and at the same time his image apparently just above the road surface in front of him, with a clear bit of mirror-like mirage on each side. So, too, I have seen a red glow in the sunset sky reflected as from a distant pool of water.

I did not measure distances, but estimated the interval between eye and mirage at from 75 to 300 yards on different occasions.

Yours faithfully,
A. A. ROBERTS.

Brooklyn, Pretoria.

In the article on Weather Recurrences in our last issue it was noted that no rain had fallen in London on the morning of March 16th for 50 years. When this notable record was maintained this year, the event was duly chronicled in our national evening dailies. We congratulate them on their vigilance in watching the columns of DISCOVERY.

Mr. A. Hampton Brown has retired from the position of Assistant Secretary to the Royal Meteorological Society after serving on the office staff for forty years. Miss E. N. Kidner, B.A., has been appointed to succeed him.

The Physics of the Divining Rod.

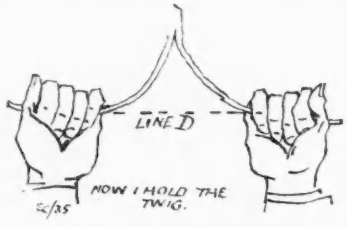
By Ernest Christie.

Member of the British Society of Dowsers.

The art of water-divining has lately been attracting much attention and many remarkable feats have been placed to the credit of dowsers. The exact nature of the power they wield is still uncertain, and Mr. Christie has been making a series of experiments with a view to elucidating the mystery. Some of his results are here recorded, and one point at any rate is proved: that there is nothing "mysterious" about the power, which is subject to finite natural laws.

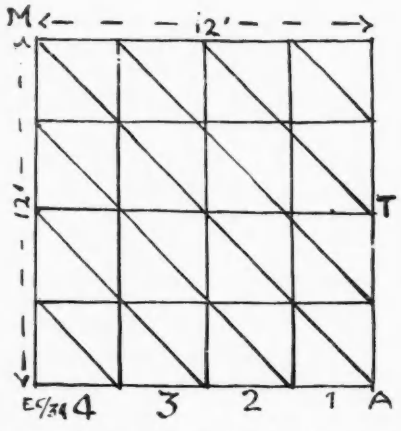
In this article I can do little more than give an outline, but I will endeavour to place the case before the reader in as simple a way as I can. Unfortunately, the proportion of Diviners who are able to get the finer details is very small, and a long, practical experience is necessary in order to learn the capabilities of the rod.

First of all there are several points of the utmost importance to be kept constantly in mind. Between the points where the twig emerges from the little fingers of the right and left hands (say *R* and *L*), runs a line of power which I call "line *D*," and it is essential to see that this line *D* is parallel with a line or sheet of power, and that the power in such line or sheet passes through line *D* in the direction of *R* to *L*, otherwise we are attempting to tap what is really a negative, and blunders are bound to occur. The narrowing and widening of these points *R* and *L* can be compared to the turning of the tuning discs of a wireless set, and to ignore this action at the twig places the diviner much in the position of a listener who would turn on his set, and leave it to tune itself in. From a height of 12 feet from the ground I have located what is clearly an atmospheric moisture area in which the main divisions occur at the radial distance, or "wave-length" for water—3 ft.—and the sub-divisions are controlled by the amount of moisture in the atmosphere. If I approach a cardinal or quadrantal point of the compass, keeping my twig at a height of rather less than 3 feet from the ground, holding the point of the twig very slightly up, my twig will rise at intervals of a yard. At the height of 3 feet my twig would act as if held at the point in a sheet of magnetism, or "blanket"; if the hands were raised the twig would appear to pull down, and if lowered, it would rise. If I mount a ladder I would find this action repeated at 6 feet, at 9 feet and, finally, at 12 feet; above which there is a distinct change. These horizontal blankets are shown as horizontal lines in the diagram, and if we consider the diagram as mounted on a card, moved about as the description proceeds, it will help to illustrate the case. In this area there are vertical sheets of power 12 feet high, a yard apart, in a fixed position.



The dowser's hands and the divining rod.

There is one series in connection with the cardinal points of the compass, and another in connection with the quadrantal points. Let us take the North first. As I face the North, I am standing in a yard-wide alley, or "zone" between two walls, as it were, with a vertical sheet of power from the South to the North, at my right. Here we place the card with *T* to North. At my left is a similar sheet with the power from North to South (card with *T* to South). There are similar sheets between East and West (*T* to West), and West and East (*T* to East), and so, with the horizontal blankets, the power is plainly divided into yard cubes.



"Card diagram," showing the divisions of power in the atmosphere.

Still standing in the alley facing the North, I have from the top of each sheet between the East and West, and West and East, a long sheet of power running forward in this alley, down at the angle of 45°, taking in 12 feet. Actually we have a similar division running forward and upwards (omitted in this diagram). I will deal with this point later on. If I walk forward in the *T*-to-North sheet, keeping the point of my twig slightly down, my twig will dip down at intervals of a yard—this I call the saw-tooth pattern. To follow this up, I mark the divisions at three yards, 1, 2, 3. Holding

my twig with the point slightly down I pass it forward at No. 1, and my twig locates the power down from the top of No. 1 to the foot of No. 2. Then with the point of my twig slightly up, I locate the power from there up to the top of No. 3. Going back to my first position, with my twig at the foot of No. 1, with the point of the twig slightly up my twig follows the division upwards to the top of No. 2, and then by lowering the point, locate the power as down to the foot at No. 3. If I step a yard to my left, and face South, I can trace the power in the *T*-to-South sheet in the same form, simply reversed in direction. There is a connection between these two vertical sheets, with the same pattern horizontally. Here, instead of the divisions zigzagging up and down they zigzag across and thus we have six sets of alternating currents.

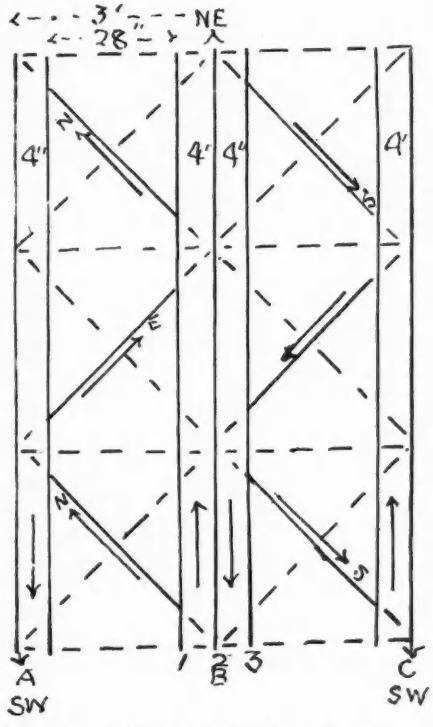


Diagram to illustrate the alternating currents of power along the zone sheets.

We may now go into the details of one of the cubes. I select a cube (that at No. 1, say), and, standing outside each face in turn, I pass my twig forward at the outline, and my twig rises at this, a moisture division ; then at 5 in. beyond for a sheet (sub-division) attracting silver ; at 9 in. for a sheet for copper ; and at 16½ in. for a sheet for iron. If the reader will refer to the " table diagram" (p. 122) it will be seen the sub-division sheets run down to the angle base only. That these divisions do actually attract the power can be proved in two ways. If I hold a small sample bottle of water or a wet rag in my right hand the twig will be " charged " and will point at the cube outline, with a silver sample, to the division for silver ; with a copper sample, to the division at 9 in. ; and an iron sample will make the twig point at the division at 16½ in. With line *D* in the moisture division my twig will be charged in just the same way as if I held an actual sample. So, when my twig has risen at the outline, I turn the twig to my left, with the point almost upright and line *D* at right angles to the sheet, and if the twig then turns to my right, as the twig always turns against the direction of the power, this means it is passing through line *D* from *R* to *L*, and what I want. If it fails to do this I step a yard ahead and get what I want at the next sheet (say No. 2).

I then raise the twig to about the height of my mouth, keeping the point almost upright, and slowly turn, taking care to keep line *D* in the sheet, and in this manner my twig will pick out the best springs in a field of, say, 5 acres, or a pond. With line *D* in a silver sheet, I could locate a silver object at a distance, and so on. This is what I call the Main Zone system, and provides the base from which other forms occur.

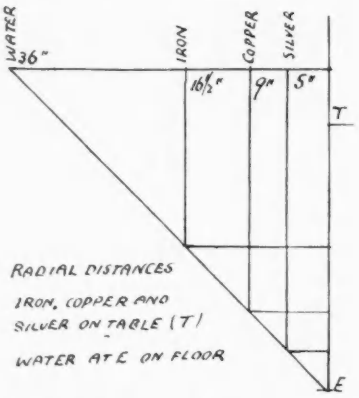
Now let us try a few simple tests with a big double magnet (from a magneto).

I place the magnet flat on the table with the prongs extending over the edge, and, suspending a needle on thread, hold this at the prongs.

The needle blows away from the negative prong, and flies to the positive—let the needle but touch, and it will be magnetised, with the negative pole at one end and the positive at the other becoming in other words, a bar magnet.

There is far too much loose talk of " radiations " and " emanations "—mere guesses, and not good guesses at that. Let us put these on one side, and try to get at the truth. We have the sun power down towards the centre of the earth, and in its passage magnetising all things. Nothing will actually cut out light power. I can locate by the pointing of my twig the position of the sun, in a direct line, long after the sun has gone down, or even the flame of a candle through a brick wall, but the slightest thing will act as an interruption in the light and cast a shadow, and it is at the shadow my twig rises. At the surface of the earth and deep down in the earth we get reflections ; a sheet of water, for example, in the yellow clay has been the greatest cause of error in depth-gauging in the Weald, as reflecting the light (upwards), it spreads the power at the downward power of light, and weakens the action on the twig. It took me years to get at the root of this, and discover a remedy. Now, under our front lawn is an underground stream at a depth of 30 feet, and as the flow is in the direction NNW.-SSE., this offers a suitable site for our test, as it runs at an angle to the cardinal and quadrantal points. The running of this stream attracts

power as a sheet, which may be likened to a sheet of glass charged with moisture, and acts as an interruption in the power of light, and casts a shadow. If I hold my twig with line *D* vertically at the side of this sheet, my twig will " blow away " (turn towards me), at the upper part, and will pull to the lower—negative and positive action, respectively, as we found with the needle and the magnet—indicating, therefore, a sheet of magnetism. The power travelling in the main zones on arriving at



" Table diagram," showing the radial distances for iron, copper, and silver as well as water.

this sheet is checked ; part passes through—not even the brick walls of the house will stop it—and part is diverted. Thus we find, at each side of the stream sheet, four parallel alleys, or " zones," locatable at the " wave-length " for the stream. Here I will place the card at right angles to the sheet, with *T* at the sheet, and it will be sufficient if we confine our attention to the zones at one side of the stream only. Here we have the diagram representing the angle divisions correctly—all down towards the stream sheet. In the " recoil " the power at these angle lines is strengthened, so that the Power from the upper outer corner to the lower inner one (*M-A* on the diagram), now becomes the main angle division, and this too can be likened to a sheet of glass charged with moisture—the power being doubled here, while the power in the zone area is compressed. It will be noticed that we have a square of 12 feet. That the compression is actual is confirmed in this way : if I locate the North, standing in the 12 feet area, I will be holding my twig with *R* and *L* 5 in. apart, but as I walk out, away from the stream, directly line *B* is beyond the area I have to widen these points to 6½ in., in order to get my twig to act, the pressure then being evidently less. I will number the zones outwards, as shown at the foot of the card, 1, 2, 3 and 4. In Nos. 1 and 3, I have to walk in the downstream direction in order to get my twig to rise, and in Nos. 2 and 4, in the upstream direction. If I stand on the " sunny side " of the sheet, that is in the early morning, with my back to the sun, the power will be weak, but if I interpose my shadow, then there, where the shadow falls, the power will be strong. On the other side of the sheet, facing the sun, I am in the shadow, and the twig acts strongly. Now for a most important point. At each side of the stream sheet is a 4 in. band, or " zone," and, looking downstream the power in the left-hand band is downstream, while that in the right-hand band is upstream. These bands occur in connection with every zone sheet, and, always, looking along in the direction in which the power is travelling the power in the left-hand band runs forward.

As we are near the stream let us try another test. The effect of rubber is not understood, so I put on a pair of rubber-soled boots and stand facing the S.W., say, and put my right foot across the stream. No action on the twig. I withdraw that boot, and place my left foot on the stream, and the twig rises. If, however, I hold my twig further downstream again there is no action. I get a flower label and place this across the stream line, and downstream from this there is a blank yard. Still wearing the rubber boots I cross the stream, and turn about, and just downstream from the label, my twig rises. The reason is this, that label on the stream line acts as an interruption, and the power is reversed, and so I now get the power (it being as upstream) passing through line *D* from *R* to *L*. (One of many tests.)

Not knowing one of these things how would it be possible for anyone but an " expert," to arrange reliable tests for dowsers ? On several occasions writers on divining have said that the power was an unknown force, and had never been explained, but I say that, without a knowledge of the power in the zones, the writers would be quite unable to understand the explanation ; a very different thing !

Photographic News.

Dr. C. E. K. Mees, whose Christmas Lectures on Photography recently delighted large audiences at the Royal Institution, is to embody the substance of them in a book for the general public which Bell's will publish in the autumn. Among the topics with which he will deal are the methods used in the manufacture of photographic films ; coloured photography ; the making of motion pictures, cartoons, and sound recording ; the application of photography in many fields of science and industry ; and the photography of coloured objects in black and white.

The March of Knowledge.

Telephone-Television.

Telephony combined with television so that the speakers at each end of a circuit can see one another's faces was demonstrated in America some time ago. In Germany a service of this kind has now been inaugurated between Berlin and Leipzig, a distance of just over 100 miles. A mechanical system of scanning is used. A head and shoulders image of the person communicating appears on a screen just under 9 in. square, and although somewhat reminiscent of the early days of the motion picture, it is reported that the portraits are easily recognisable. Facilities seem likely to be restricted at the moment to special equipment at post offices or telephone exchanges, as few individual subscribers would be willing to incur the expense of the special installation required to enable them to see and be seen when telephoning from their own offices or residences.

André-Marie Ampère (1775-1836), *a great worker in the cause of Science, whose centenary has just been celebrated by an Electrical Congress at Lyons, his native city.*

Tropical Medicine.

Research in tropical medicine has always been of concern to the Medical Research Council, and the establishment of a Tropical Medical Research Committee is now announced. The decision to appoint this new body has been taken by the Council in consultation with the Colonial Office. The new committee will advise and assist in the direction of such investigations as the Council may be able to promote, whether at home or abroad, into problems of health and disease in tropical climates, and make suggestions generally as to research in this field.

Pernicious Anaemia.

Sufferers from pernicious anæmia, a disease which was reckoned incurable until 1926, and which, since then, it has been found possible to keep under control by large and frequent doses of fresh liver, can look forward to a less unpalatable cure. Investigators of the Medical Research Council, after tests, have confirmed the discovery of a cure, largely due to Dr. H. D. Dakin, a Londoner who had settled in the United States, but returned to this country to perfect his researches and experiments. The substance employed is anahæmin, the active principle in the liver of a healthy man, and the investigators in their report state that "injections of from 0.1 to 0.2 gm. of the active preparation once weekly, brought about a large increase in the red blood corpuscles of the patients, and in the course of a few weeks restored them to health."

A Dowser's Feat.

The publication of an article on the Divining Rod in our current issue makes it worth while to recall the success of a dowser in locating, last month, the body of a carpenter who had been missing from his home at Dedham, Essex, for some time. Armed with a copper wire and a piece of the missing man's clothing, the diviner indicated a spot in the Stour river, from which the police soon recovered the carpenter's body by dragging in the river-bed.

Grey Squirrel Pest.

The grey squirrel is again becoming a serious pest of the countryside. In 1931 its numbers in this country were greatly reduced by an epidemic disease: in consequence it was much scarcer in 1932 and 1933. Investigations in 1934 and 1935 showed, however, that the pest had made a substantial recovery and was spreading over fresh areas. The Ministry of Agriculture, therefore, hopes that all connected with agriculture or horticulture will do their utmost to encourage the destruction of these arboreal pests by shooting and trapping, and so prevent them from spreading into other districts and establishing themselves there.

Old Paintings Preserved.

The discovery that changes in the humidity of the atmosphere are a factor of the first importance in causing deterioration in paintings on panel has led to interesting results in the National Gallery of Scotland. Some ancient double-sided panels, with royal portraits, threatened with complete disintegration, were subjected to the new treatment, and with great success. The treatment consists in enclosing the paintings in glass-sided cases, in which are receptacles containing a mixture of two salts. One of the salts absorbs any excess of moisture in the air; the other automatically moistens the atmosphere when it becomes too dry. This successful experiment was carried out by experts from the British Museum, the Office of Works, and the Department of Scientific and Industrial Research.

Book Reviews.

The Case Against Arithmetic. By E. W. RENWICK. (Simpkin Marshall. 5*s.*)

This is a very thoughtful and useful little book, though one may fairly take exception to its title. It is not in any sense a "case against arithmetic," but a case against the ideas set forth as to the teaching of arithmetic in a report by the Consultative Committee on the Primary School, published in 1931. Miss Renwick is herself a teacher of mathematics in the West Hartlepool High School for Girls, and no doubt she deals largely with pupils who have come from the primary school and with other girls of about the same age. The gist of the book is, that the Committee in their report talk very lightly and confidently about results and problems in the teaching of arithmetic, which Miss Renwick has found in a long experience to be contrary to the facts—at least of her school. She goes minutely into the question, quoting girl after girl, and process after process, showing the mistakes in comprehension which they make and how generally they fall short of the smooth ideal painted by the Committee. It sounds rather a petty business, but it was well worth doing and Miss Renwick has done it very well indeed. She ends with a short chapter, giving some suggestions for reform based on her experience.

One hopes Miss Renwick will pardon one general remark which may seem to smack of masculine arrogance. But is it not the fact that her experience has been mainly, if not exclusively, with girls? At any rate, all her examples are quoted from girl pupils. And is it not also the case that the teaching of mathematics to girls and women generally is one of the later novelties in education? The recent systematic teaching of mathematics to girls—approximately on the same lines as to boys—has indeed been the greatest advance towards the rationalising of the whole human race since formal education began. Our grandmothers, and still more our great-grandmothers, were sometimes better taught languages, art, and even history than their menfolk, but they were never taught reasonable counting and measuring. And, quite apart from any possible difference in the sexes in this matter, age-long tradition and habits of thought are bound to have some persistent effects. Hence one would suggest to Miss Renwick that girl pupils, even at the present day, tend to be less apt in dealing with abstract ideas, slower at mathematical reasoning than their brothers. This is no condemnation of her ingenious methods for making them think and for testing their thought. But it does suggest that the general impression which we should have to draw as to juvenile intelligence from her experiments, would be rather brighter if boys were included. My own experience is that girls are almost invariably brighter in language and artistic impression and in memory for particular things, but are, on the contrary, weaker in matters involving generalisation, the connection of thoughts and facts, in reasoning, that is, rather than in tuition.

Probably nothing better has ever been done than this little book in elucidating this special region of the child's thought. One finds oneself reading on and on, in spite of the need of very careful following, and at the end one has acquired a surprising amount of enlightenment as to some of the dark places in our minds. For we have all at some time, either grappled with, or slurred over, just those very obstacles to clear thinking which Miss Renwick has brought out with so much pains and profit in exercise with her pupils. This is psychological analysis of the right and fruitful order, because it deals with the processes of the conscious mind, and is calculated to make that mind more sure of itself, and, therefore, more effective.

So far from making out a "case against arithmetic," Miss Renwick has convinced us that, if properly used, it is the best mental discipline in the school curriculum. In making a case against the pundits who pass lightly over the task, she is unanswerable, because she is thorough. Everyone—certainly every teacher—should read the book.

F. S. MARVIN.

How Organisms Develop. By C. H. WADDINGTON. (Allen & Unwin. Cloth, 4*s.* 6*d.*, Paper, 3*s.* 6*d.*)

This little book provides a brief account of embryology and the processes of development in the light of recent experimental work. It has been the author's aim to make it intelligible to laymen with no knowledge of the subject or of biological terms. Considering the unfamiliar and specialised nature of embryology, such an attempt must inevitably present great difficulties. He may certainly be congratulated on its entire success.

Naturally, the concept of the "organiser" is given special attention; but all the aspects of the subject are extremely well developed. Though not ostensibly written for them, advanced students should read this book. They may well profit from the clear summary presented here by one whose own researches have helped to enlighten the problems he discusses.

In the probable event of a future edition, the description of the gastrula in which it is stated that "the ball (i.e., the blastula) is punctured" (p. 23) should be amended. Although well described later, this is most misleading as a preliminary statement, suggesting, as it does, that the blastocoele becomes the primitive gut. It is refreshing to find an elementary account of cell-division in harmony with recent cytological discoveries. But the simple description of meiosis (p. 30) should be perfected by pointing out that though the chromosomes are not split longitudinally when they first appear, they become so before their separation. This fact could easily be introduced, and would complete the comparison with mitosis which the author has wisely drawn. Finally, the statement that the amphibia are the most primitive land animals (p. 103) should be corrected to indicate that they are only the most primitive land vertebrates.

E. B. FORD.

The Voice of Atlas. By PHILIP THORNTON. (MacLehose. 8*s.* 6*d.*)

Mr. Thornton's broadcast talks on exotic music are widely known and greatly appreciated; and he has at last been induced to set down in print his experiences in studying the technique and collecting specimens of the music of Morocco. In the book under review he does far more than that; indeed, the chapter devoted exclusively to music occupies little more than one-sixth of the volume; but his account of Moorish life and customs is enlivened throughout with apposite musical illustrations.

To the untrained European ear, the music of Morocco, with its multifarious modes, its fractional tones, and its uneven and crossing rhythms, may sound like little more than a children's concert, but Mr. Thornton has gone into the subject deeply

and finds that true understanding leads to an appreciation of the fuller beauty of its intricacy. The æsthetic sense of the Moors and Berbers is very diverse from ours—some say that ours is simply spoilt by civilisation—and Mr. Thornton is not alone in discovering that a Berber can appreciate a drawing held sideways or upside-down quite as well as when it is right side up. A significant fact throwing light on their musical appreciation is that, out of a selection of European gramophone records, ranging from plainsong to Mousolov, it was the music of Bach, with its perfect counterpoint and logical working-out, that met with the greatest approval from a Moroccan audience. All the same, the elaborate technique evolved by the professional musicians, and the extraordinary dexterity and practice needed to play the local instruments are terrifying to the tyro.

The unmusical will find the descriptive chapters most entertaining. Let it suffice to say that the author has discovered the truth that the public motor-bus affords the best method of getting to know the people of a country. His adventures are many and varied, and the selection of fairy-tales and experiences with magic are well selected. Berber hospitality is still free and generous, despite the advance of Europeanism. Mr. Thornton wonders whether a foreigner would have met the same generous treatment in the Scottish Highlands as he encountered in the High Atlas. Before the encroachment of civilisation that would be the one place in Western Europe where he would most likely find it. Hard conditions induce the hospitable hearth.

This Business of Exploring. By ROY CHAPMAN ANDREWS. (Putnam. 15*s.*)

Dr. Andrews has as good a claim as any man to tell the story of present-day exploring; and in the present book he justifies his claim to the full. Anyone may read *This Business of Exploring* with keen interest, but to those who are seriously thinking of taking up a life of exploration it is a work of surpassing value, if not of absolute necessity. To members of the Public Schools' Exploration Society, for example, it will come as a godsend.

Let there be no mistake: this is no misguided outburst of enthusiasm over the charms and excitements of exploring. In the first part, which is devoted more strictly to the subject-matter indicated by the title, Dr. Andrews strikes a very fair balance between the pros and cons of his profession; but the outstanding fact remains, if exploring is in your blood, you just have to explore. Adventures, says Dr. Andrews, are generally a mark of incompetence, and he was rarely more infuriated than when a member of Byrd's Antarctic expedition criticised it as "too easy to be interesting." Actually this was a splendid though inadvertent compliment to Byrd. The contrast between the comparative safety of Mongolia and the dangers of New York gives food for thought; the untimely end of that prince of explorers, McKenzie Young, was brought about, not by a horde of Chinese brigands, but by the treachery of a pair of roadside thieves in Nevada. The Mongol bandit, at any rate, shoots his man from the front. McKenzie Young was the personification of loyalty, unselfishness, and dependability—the explorer's three cardinal qualities. The lighter side of an explorer's life is well indicated in the chapter on pets; Connie, the vulture, would be an ornament to any expedition.

The second part of the book describes the Central Asian expeditions organised by the American Museum of Natural History. It contains much fascinating descriptive matter, from the discomforts of a Gobi sandstorm to the thrill of discovering the *Baluchitherium*, the world's largest mammal. Bait for future expeditions is held out in the appendix. What is the mystery of the stone-age Dune Dwellers? Is the secret of the origin of the human race still concealed in the Gobi Desert that was once a pastoral paradise? So long as such questions remain unanswered, and so long as governments like the Chinese interpose unending difficulties between explorers and their goal, there will still be a call to be answered by the restless spirits among mankind.

Stratosphere and Rocket Flight. By CHAS. G. PHILP. (Pitman. 3*s.* 6*d.*)

The historic flights into the stratosphere by Professor Piccard and, more recently, the successful venture of the United States Army balloon, *Explorer II*, have captured public imagination and aroused a profound interest in this new and strange region which adds, as it were, another dimension to the old limits of the upper air. Man's efforts to conquer this realm form the subject of Mr. Philp's latest handbook, which is written in popular vein.

Though covering with equal diligence every phase of high-altitude flight, the book is chiefly concerned with the development of rocket-systems of propulsion, which, though not yet sufficiently practical in their present form, appear to have high potential values. The efficiency of the reaction-motor beginning where that of the propeller leaves off, at approximately the 10-mile level, piquantly raises the question as to whether certain makers of hush-hush "stratoplanes" are not working along the wrong lines. The author discusses clearly the various rocket fuels which have been tried and details thoroughly every experiment of practical importance.

Certain technical points to which exception might be taken are related in the last chapters, where the author has ventured to be prophetic, but these are debatable. For example, the war-rocket, with a minimum range of 500 miles, to which a chapter is devoted, is a disconcerting revelation in these restless times, but a ballistician would doubtless regard its possibilities unfavourably. Radiogoniometrical control of such a projectile, as the author proposes, is quite beyond accomplishment at present—shall we say, fortunately—and the alternative use of controlling fins has been proved by experiment to be hazardous; in fact it is easily possible for a deflecting wind to cause a shot to boomerang.

These points are, however, of minor importance, and the book is well worth reading, if only for the imposing array of scientific facts which the author has marshalled in support of his subject.

J. G. STRONG.

Life of the Shore and Shallow Sea. By DOUGLAS P. WILSON. (Ivor Nicholson & Watson. 12*s.* 6*d.*)

A Natural History of the Seas. By E. G. BOULENGER. (Duckworth. 7*s.* 6*d.*)

The numerous books that have recently appeared dealing with the seashore and the inedible portion of its organisms, indicate a great change in the attitude of the public to biology. Not so long ago the authors would have been reckoned among the almost certifiable.

Mr. Wilson is a naturalist in the fullest sense; he is a photo-

grapher of the first class; and he has found publishers willing to print his photographs in the best possible style. The result is a really beautiful book, with every illustration a pleasure, from the views of a rocky coast, inside the covers, to the last of the 128 photographs of animals. The coloured frontispiece, showing a stone dredged from 15 fathoms bearing sponges, alcyonium, etc., is especially beautiful, and the octopods of Figs. 64, 89, and 90 are particularly fine, both as illustrations and as photographs. It is to be hoped that a number of these will enliven future text-books. Fig. 97, for instance, showing the expanded polyps of a "sea fan" (*Eunicella verrucosa*), is quite novel, showing life where nothing but dead stalks, perhaps supplemented by an outline drawing of one expanded polyp, are usually seen.

Mr. Wilson's outlook is ecological: after a short description of the principal groups, too short perhaps, were it not supplemented by later familiarity with marine animals of every sort, the book is concerned with the influences under which these animals live and their various and often extraordinary ways of movement, feeding, and breeding; in short, how they live, and why most species are found only under certain conditions, not scattered at random but surrounded by an assemblage of other organisms forming definite communities.

The present writer, a biologist by profession, has found the book not only charming, but profitable. It contains much new or recently acquired information, but above all it is first hand, Mr. Wilson's acquaintance with shore and sea, and all that has been done in their exploration, being evident throughout.

The appendices on observing, collecting, aquaria, and photography are short but practical, and it is evident that the author hopes that his book will lead others into the laborious but delightful paths he has chosen.

A Natural History of the Seas is a bold title, calling up a picture of a shelf of large volumes—far too bold for 200 pages of large print. Ten chapters give a description each of one or more groups of the marine fauna, the eleventh, very short, being devoted to sea monsters.

The attempt to interest the general reader in so brief a description of so many forms does not seem to the present writer to be likely to succeed. For example, Chapter V deals with Turbellaria, Nemertines, Polychæta, then the leeches and Polyzoa: all in nine pages! Such fragments are hardly worth knowing, nor is the general reader likely to find them acceptable.

The book has been hurriedly written, and there are misspellings, of which "a temple of Ceraphis" is the least likely to mislead. On the next page "mussel" is given for "muscle." The "true" pearl oysters are distributed over a range much wider than India, Ceylon and N.W. Australia.

The paragraph on corals (p. 26) is hardly useful, and again on p. 28 the uninformed reader will be led to think that the coral of the jewellers is much the same as a reef coral. Certain reef corals are used for buildings other than stables, even though "pressure exerted by later generations" does *not* "consolidate the vacated homes of defunct members into one massive block."

The Great Barrier Reef and Cocos Atoll are not the only famous reefs in the world and the latter is not "notorious." The shelter afforded by an atoll does not make the lagoon particularly rich in life; often the reverse is true. The phyllosoma larva of the "crawfish" may be one of the most striking, but is far from being a typical crustacean larva, though it is the only one figured. Ormers do not reach their maximum size in tropic seas, those of southern Europe and California being giants compared with those of the Indo-Pacific tropics. Not even whales "shape their courses as their inclinations dictate." Lampreys are not really parasitic, and the deep-sea angler, in which the male is truly parasitic on the female, is not a large fish; the male is relatively very small, much less than one tenth the bulk of the female.

The nine photographic illustrations are of fair quality, though spoiled by contrast with Mr. Wilson's. There are numerous line drawings by L. R. Brightwell, which are far more lifelike, but I do not think he has seen a flying-fish alive.

CYRIL CROSSLAND.

Sons of Ishmael: a Study of the Egyptian Bedouin. By G. W. MURRAY. (Routledge. 18*s.*)

It has often been remarked as a matter of literary criticism that contact with the desert produces great writers. Whilst we desire to initiate nothing in the nature of a competition, high marks must be assigned to Mr. Murray for the vigour and fidelity of his portrayal of Bedouin character and mentality. Grim as that character may be in its firm grasp of the basic realities of desert existence and lack of imagination, as Mr. Murray views it and conveys it to us it is not without its attraction. Its steady concentration on the business of life, as it must be lived in these strenuous conditions, justifies the author's opinion that "in the last resort, when the fires of the world burn low, the Bedouin-minded will be found to survive the peasant or the town-dweller."

The nomad Bedouin tribes of the Egyptian desert and the Sinaitic peninsula must, in fact, have attained a state of stable equilibrium between their mode of life and their environment at a very early stage of their existence. In part Hamites, in part Semites in the looser sense of the ethnologist, they seem, in so far as the Hamitic tribes are concerned, to have remained virtually unchanged in physique since predynastic times; while in custom and belief, neither the Egyptian empire, to whose people they were akin, nor Islam, nor the Great War, effected any fundamental change. They still retain pre-Islamic cults and beliefs.

One of the most remarkable, and probably the best known, feature in their culture is their hospitality to the stranger and the fugitive—a direct outcome of their life in desert conditions which offer no alternative shelter to the traveller. The inviolability of the tent is an important factor in paving the way to the settlement of feuds; but the bond of food, while it lasts, a period of three days, is stronger than even the blood-tie.

Mr. Murray in a service of twenty-five years under the Egyptian Government has traversed the desert from end to end and has had an intimate view of the life of the various Bedouin tribes such as has been accorded to only a very few others. His readers are indeed fortunate in his skill in recording this knowledge in vivid detail, while for the anthropologist his book is a valuable and illuminating supplement to previous accounts of these tribes.

Aquaria and Garden Ponds. By W. HAROLD COTTON. (A. & C. Black. 2*s.* 6*d.*)

The interest attached to a garden is never-ending, and the enthusiast, whether he be amateur or professional, is always keen to add to his joys. The garden pond will thus give added interest to the gardener inasmuch as the partially hidden life creates curiosity, and with this curiosity there opens a new field of knowledge. A new hobby is started. First of all comes the design and construction of the pond or aquarium; then fish-keeping and the raising of water plants. All these need investiga-

tion as to their maintenance and upkeep, and the author, having had practical experience, has written a book which covers the subject, and forms a very useful guide for those who contemplate taking up the hobby of fishkeeping in ponds or aquaria, as well as water plants.

There is no doubt that the attraction of garden ponds and aquaria is on the increase; they are fascinating, and, if carried out with thoughtful planning, may add to the beauty of a garden. The book is written in simple language, and the English names of plants are given in addition to the Latin names. The information given will be found indispensable, and if it is studied carefully many disappointments will be avoided. There are ten full-page illustrations, with two in colour, which add to the value of this work.

A Fugue in Cycles and Bels. By JOHN MILLS. (Chapman & Hall. 13*s.* 6*d.*)

The subject of this work—the electrical production and reproduction of music—is treated "fugally"—i.e., from varying view-points: those of the electrical expert, of the music-lover, fnd of the "ordinary listener." Mr. Mills, an American engineer, divides his book into three parts: the first, an excellent history of acoustical discoveries, including Bell's telephone; in this section he describes also the system of measuring intensity of sound by decibels.

Part 2 includes a brilliant exposition of radio telegraphy and telephony, also accounts of recent tests, both of pitch and intensity of sound, with amazing results. Musicians will be interested in the effect of overtones on the "loudness" of a note. A detailed account of the ear's conformation follows; then comes the curious fact that "subjective" overtones can be heard above a perfectly pure tone of sufficient intensity. Other subjective effects are described, e.g., pitch is influenced by overtone structure (compare slight changes in hue causing by altering *quality*—in colour).

Part 3 deals with "power" at different pitches; then with auditorium acoustics; finally, the author foresees a time when the musician of to-day, and his instruments, will alike be things of the past, but when music will still exist, produced by electrical equipment alone, yet with all its proper frequencies, including the harmonies—right intensities—and time, correct to the 100,000th part of a second. But, he sympathetically asks: would such a performance, shorn of all temperamental and psychological variations, be enjoyed by an audience?

Men Against the Clouds. By RICHARD L. BURDSALL and ARTHUR B. EMMONS. (The Bodley Head. 12*s.* 6*d.*)

This is the record of the Sikong expedition of 1932, which had as its main objective the first ascent of Minya Konka (24,900 feet), highest of the range of mountains between the Szechwan basin in Western China and the high grasslands of Tibet. Four young men, Burdsall, Emmons, Moore, and Young were the members of the expedition, which, for the purposes of this book, began at Shanghai in June. Richard Burdsall tells the story of the journey up the Yangtze River to Kiating and thence overland by way of Yachow and Tatsienlu to the neighbourhood of the mountain, an introduction which is in itself an interesting addition to the existing books on travel in China and Tibet. Arthur B. Emmons takes up the tale and describes the actual assault on the mountain.

Porters went no higher than 12,700 feet. Hereafter, loads were carried by the climbers themselves, this being to a certain extent an advantage in that they were broken in at relatively lower altitudes and were made more fit for the packless final stage. High camps were pitched at 18,000, 19,800, 20,700, and 22,000 feet. The attack began on October 2nd, and Camp III was established at 20,700 feet on October 14th by Emmons and Moore, who spent three nights there acclimatising themselves to the altitude, prospecting by day the subsequent route up to 23,400 feet. These two then returned to the base camp for a short rest, ascending again on October 19th. On October 26th, at Camp IV, Emmons had the cruel misfortune to cut his hand very badly in trying to slice a frozen biscuit with his pocket knife. This prevented him, on the morrow, from sharing with Burdsall and Moore the honour of reaching the second highest summit ever attained by man.

On the descent Emmons discovered that both his feet were badly frostbitten and so left his companions in an attempt to reach the base camp in one day. He failed and spent an uncomfortable night under the sky before he was found by two of the porters from the camp. Young had remained there during the final attack to carry on his work of collecting specimens for the Academia Sinica in Nanking, and he contributes a series of admirable Hunting Notes, which, together with Surveying Notes by Burdsall, and Mountaineering Notes by Emmons, round off a very satisfactory book. The many photographs are first-class and really illustrate the text.

A Geography of Europe. By RAOUL BLANCHARD and RAYMOND E. CRIST. (Methuen. 12*s.* 6*d.*)

Professor Blanchard of Grenoble, who occupies a Chair in Geography at Harvard for the first term of each academic year, has written a valuable geography of Europe. It has been ably translated, primarily for the use of American students, though the book can be recommended strongly also to English undergraduates and to the general public.

The description is always well informed and suggestive. The great mass of material has been admirably organised and the detail carefully selected; comment is concise, yet always shrewd and cogent. Modern political and economic problems receive a scrupulously fair treatment.

Though the various countries are considered separately—for, as the author notes, the influence of the country works powerfully on the various geographic phenomena—the standpoint taken is that the continent is naturally a single organism. An attempt is made to give the United States of Europe physical and human characteristics. Two concluding chapters on the forces which unite and divide ("balkanise") Europe are provocative of thought, if not of agreement.

Statistics of population and economic data are generously provided, though not always sufficiently up-to-date (Danzig tonnage; Polish oil output). The book is illustrated with a large number of well chosen photographs, but it is unfortunate that the re-drawing of the all-too-few maps has been so crudely done. This applies particularly to the maps of Germany and Russia; exception must be taken also to the map of England, which shows a deeply indented coast of Norfolk, severs Pembroke from Wales, and, as a result of using a county basis, gives a completely false picture of land under cultivation in England

and Wales. In the map of Ireland two summits only are shown—Croagh Patrick and Errigal—and both are wrongly placed. Loch Linnhe appears in two places as Loch Lonnhe. These, however, are minor blemishes in the adaptation for English readers of an excellent and valuable book.

J. A. MORRIS.

Tools of To-morrow. By J. N. LEONARD. (Routledge. 12*s.* 6*d.*)

Many books on ultra-modern methods soon decay into a smug recital of the wonders of the age. *Tools of To-morrow* is not such a work. Mr Leonard does, in fact, parade before the reader some of the most startling inventions of the period, but he is more concerned with possibilities than with facts, and no book was ever a more damning indictment of the futility of the world as it is

The author shows us a brave new world indeed. A world of stainless steel, rotating in peerless oil-baths, governed by faultless photo-electric cells. And he compares it with this musty globe, rotating jerkily on rusty bearings, appallingly subject to political winds and the fluctuating tides of vested interest.

It must not be understood, however, that the book is written in a bigoted or intolerant style. The author writes more in sorrow than in anger. He feels that he must apologise because he shows us the glittering prizes of our inventive genius and then has to say, " I am sorry, you cannot have them yet. There are non-technical influences to be considered." He feels that it is not right that 15 per cent. of the cost of a new car should be its selling cost. He dislikes advertising, which is fashioned to appeal to " prostrate minds." He waxes sarcastic over technocracy and mildly indignant over price-control of new metals by monopolies. But one feels that he is a fatalist, and that his creed is " futility is always with us."

Tools of To-morrow has only a faint American flavour, and can be read with great interest and profit by the scientifically inclined or by those who like to watch the world go round. It is not recommended to those who believe in the ultimate good sense of the masses.

A Handbook of English Mediæval Sculpture. By ARTHUR GARDNER. (Cambridge University Press. 15*s.*)

Mr. Gardner has done a real service to students of English art by making the substance of his researches available in a book of such convenient size packed with so many really good illustrations. The amount of care and labour involved in the taking of so many difficult photographs of architectural sculpture, which is always hard to photograph, should fill the reader with admiration. But only those who work in the same field will know how great is the feat here represented by nearly five hundred blocks.

While the author avoids controversy deliberately, yet his text is neither dull nor didactic. It is most refreshing to see at last a full statement in short compass of the origin and development of Anglian and Saxon sculpture. Mr. Gardner has used all the new material recently collected and studied and has presented it here in a most acceptable form. This section is most richly illustrated, and the addition of the Breedon, Fletton, and Barnack reliefs to our repertoire of early Saxon work and of the Reculver, Winterborne Steepleton, and Ipswich reliefs to the later series will prove an enormous help to students. For the first time Saxon art takes its place on a proper scale in a handbook of sculpture. It is pleasant, too, to see the ivory of the " Deposition " in the South Kensington Museum classified as Saxon, despite the fact that it has long posed as Spanish.

The Norman period is equally thorough, and the strange carving of Kilpeck is rightly classed as derivative from metalwork. The slow development of dreary Norman figure-sculpture into something fine and sensitive can be well traced in the illustrations of this book, and the triumph of the 13th century is superbly shown in the two photographs of the Westminster triforium angels, which are, perhaps, the finest work of the sculptor's art in Britain.

Students of ancient art will find how the history and development of sculpture follows the same lines in Britain. Mediæval art had to re-discover the technique of carving and bronzework, and seems to have inherited nothing at all from antiquity. Thus, the most primitive mode of metal sculpture in Greece and Egypt was that of riveting plates of metal on to a solid core—the process that preceded casting in metal.

Mr. Gardner has lavishly illustrated his chapters also from wood-carving, so that the art of sculpture can be studied as a whole. The book should remain a standard publication for many years.

S. CASSON.

The Chemistry of Rubber. By H. FREUNDLICH. (Methuen. 2*s.* 6*d.*)

Flame. By OLIVER C. DE C. ELLIS and WILLIAM A. KIRKBY. (Methuen. 3*s.*)

These two volumes of the series of " monographs on chemical subjects " have much to commend them. Dr. Freundlich, of University College, London, gives special attention to the constitution of latex (the milky sap from which rubber is produced) and the structure of rubber itself, from the results of both X-ray and colloidal methods of investigation, and he endeavours to give the reader a full understanding of technical processes such as the preservation and coagulation of latex, and the mastication of rubber. The joint authors of the book on flame are associated with the Flame Section of the Safety in Mines Research Board. Combustion is examined from the aerodynamical, chemical, and physical aspects, and the book offers an analytical survey of the conditions which govern the ignition and propagation of flame in mixtures of mutually reactive gases. Very good bibliographies are given in each book.

Modern Science. Book II, Chemistry. By G. W. MANFIELD. (Macmillan. 2*s.* 3*d.*)

Dealing with air, water, coal, petroleum, iron and steel, acids and alkalies, soap, fertilisers, and foods, this book gives an account of " chemical " materials which have the greatest bearing on everyday life. Chemistry is here presented in its simplest form, devoid of symbols and formulæ, and without reference to atoms or molecules, or even to the theories upon which modern science is built. At the end of each chapter there is a very brief summary of " things to note," presented chiefly as a guide to the notes which students should make for their own use. A large number of experiments are described and the book is illustrated in a style appropriate for school use.

Psychology and Modern Problems. Edited by J. A. HADFIELD. (University of London Press. 5*s*.)

For five shillings we have here a collection of lectures (originally delivered at the Institute of Medical Psychology) from seven distinguished men, including Seligman, Ramsay Muir, Flügel, Dean Matthews, and others of equal stature. That so excellent a book can be marketed at so reasonable a price is a tribute to the publishing trade, and also, I suppose, to the wide public appeal of intelligent discussion.

The lectures treat of religion, art, marriage, education, and various aspects of democratic and other forms of government, so that the title of " modern problems " is well justified. The connecting link between each article is not so clear, being forged of that very variable material, psychology. Perhaps a more consistent treatment might have been obtained, had each contributor been made to answer a questionnaire beforehand on some of the stock questions: psychology, its scope, is it a science? If so, what is its relationship to the other sciences? If not, what is it, anyway? But then, some very provocative answers might have been obtained, particularly from the Dean of St. Paul's, and the freshness of free individual treatment, still so rightly valued in this country, might have been lost.

Psychology and Practical Life. By MARY COLLINS and JAMES DREVER. (University of London Press. 5*s*.)

The joint authors of this textbook draw a distinction between what they term the older and the newer psychology. In the older days, they maintain, psychology was regarded as a branch of philosophy, more or less closely allied to metaphysics. The newer psychology, on the other hand, belongs with physiology, zoology, and the other biological sciences. According to the old view, " which is still the view largely, of the man in the street," psychology was defined as the science that studies the mind or mental processes, whereas, to-day, it is defined, according to the authors, as the science that studies behaviour, in terms of the phenomena of the inner life of thought and feeling. This change of emphasis from the mind to behaviour is, they point out, very significant. As if to thrust this point well home, the authors state, " The philosopher, in spite of his professed enthusiasm in the cause of truth, has at all stages in the world's history been sufficiently human to emphasise those truths which chimed in with his own way of thinking, and to turn a blind eye upon, if he could not explain away, those facts which his theory of the universe did not seem capable of absorbing.

This mental outlook seems to us somewhat ungenerous and depressing, particularly so as the study of practical psychology or applied psychology should endow the student or the professor with a mature understanding which would specifically rather than generally indicate where the philosopher had been at fault. To expect the reader to accept the pontifical dictum of the authors is just a little too much.

As we read on this aggressiveness appears to take on the character of a fixation. In the chapter on the Measurement of Intelligence by awarding marks for intelligence tests, the following observation occurs, " It might be added that many psychologists appear to have been so hypnotised by the statistical jargon that they have failed to realise the limited extent to which it was possible for such investigations to throw light on the nature of intelligence."

The impression left on the mind of the reader is that throughout the period from 1869, when the idea of applying intelligence tests, down to the present time, the nett result has been extremely meagre. Actually, results have been obtained which would seem to promise the successful numerical cataloguing of the various degrees of intelligence from the idiot to the genius.

Chapter IX deals with Psychology and Advertising. This section completely failed to arouse our enthusiasm; moreover, the footnote at the end confirmed our disappointment. It ran thus, " For a fuller discussion, consult any of the books on psychology and salesmanship so numerous in the market." This casual dismissal of what should evoke some interesting analysis backed by incisive academic suggestion is surely an anti-climax.

This text-book is provocative and pseudo-imposing. It is, at the same time, informative, and will be found extremely useful to all who seek an elementary treatise on the science of behaviour. It contains an acceptable bibliography and is competently indexed. At the same time there is, as " the man in the street " will think, very little psychology in the volume.

Émile Coué: The Man and His Work. By J. LOUIS ORTON. (Mott. 8*s*. 6*d*.)

It is ten years now since M. Coué died and fourteen since he first came to this country to assure us that day by day, in every way, we were getting better and better. He was the high priest of hope. He was the apostle of auto-suggestion. He was neither a doctor nor a professional psychologist but a pharmaceutical chemist at Nancy in France. He had the distinction of becoming much more famous in England and the United States than he was in his own country, largely through the influence of one or two people of wealth and influence who thought they had been cured by his treatment. Despite his enormous vogue for a short time he did not become spoiled. He was not " on the make." He remained a simple, unpretentious, little man, anxious to do everything he could. His great merit was the wonderful emphasis he gave to certain facts about suggestion, the sub-conscious, the will, and the imagination, which, although well known to psychologists, wanted emphatic statement for the man in the street. Where others had merely announced, or gently taught, that the mind can effect wonders at times over the body, Coué rammed it home dramatically, impressively, and with every artifice for producing conviction. In this he was more the American of the story books, with unbounded enthusiasm for what he was saying, than the conventional Frenchman exhibiting the Gallic gift for cold and precise statement. Coué, indeed, had no theoretical or even practical acquaintance with modern work in psychology on the conscious, the sub-conscious, and the other things he talked about. He was, in fact, a child at theory. But in practice he was an amateur of genius. His success was due to his great power of exposition and to his personality. When he failed it was because he did not realise how necessarily limited his form of curative suggestion might be.

Mr. Orton knew Coué well in the latter years of his life and, like Coué, has had wide experience in practical and popular psychology. His biography is interesting and revealing. It gives the inside story of Coué in his years of fame, and especially the detail of the English and American visits. It is, however, no more than a partial success. The reader early feels that this biography is too much Orton, too little Coué. The loose

cover, the title page, the foreword, seem bent on calling attention quite as much to the author as to his subject. Later, when the author rightly criticises some of Coué's work, the norm from which the errors are measured is not, say, the consensus of Harley Street, but the particular notions of Mr. Orton himself. This mild egotism of his does not permeate the whole book but it suffices to convince the reader that the book cannot be the last word on M. Coué. It would have been better for the reader if any diaries or letters that Coué wrote had been put into the book so that the man might have spoken for himself. Perhaps none was available or suitable, but in that case there is all the more reason for the author's staying his hand. In one or two of the chapters the writing sinks to an allusive and journalistic account of trifles, interesting, no doubt, to the author, but of little use to a reader and of no value in revealing Coué the man. The general fault is perhaps more naïveté than egotism. Mr. Orton tells the reader a great deal about Coué, and much that is of value, but with too little appreciation of what is important, what trifling. The fellow-expert writing of the expert is more interesting than the hack, but there is a mistake to which he is prone: that of not detaching himself sufficiently from his theme to give the reader a well-balanced as well as an intimate account of the man he is writing about.

Prehistoric Man in Ireland. By CECIL P. MARTIN. (Macmillan. 21s.)

In his introduction to this book, Dr. Martin states that when, some years ago, he undertook, on behalf of the National Museum of Ireland, the task of reporting on some recently-discovered burials, he realised the lack of an account correlating previous discoveries and found further that in the available reports the method of description and craniological technique was not always the same. He, therefore, set out to present in their chronological setting all the available data, whether derived from the archæological literature or from unpublished material in museums and other collections, so that, having examined every known prehistoric skeleton, he might arrive at a " consecutive account of the various races that invaded Ireland." The account presented he regards as provisional and such as may " require drastic amendment as further discoveries are made."

Dr. Martin is to be commended for his courage in undertaking this work even as much as for the success with which he has carried it through. As a pioneer he has had to meet the difficulties of the pioneer, and when other workers undertake research in the field of Irish physical anthropology, they must gratefully acknowledge what has already been done in this first general treatment of the subject.

The reader not specially trained in anthropology or prehistory will find of great help the chapters on the dating of prehistoric finds and on the methods of skull measurement. The inclusion of a treatment of the latter subject in a form so easily appreciated is particularly welcome, and it might have been well if something had also been said of the measurement of the skeleton in general. A chapter is given on Some Recent or Modern Irish Skulls, and another summarises the present state of knowledge of the physical character of prehistoric man in Ireland and Great Britain.

The succeeding chapters are concerned with the Irish skeletal material—subdivided according to chronological considerations. It is interesting to note that the author accepts the early dating of the Kilgreany B skull, notwithstanding the arguments recently put forward to the contrary. An interesting summary of other discoveries of human remains in caves is given but, because these are all the work of early investigators and because cave excavation is so difficult, we cannot think of them as evidence of palæolithic habitation. The division of the early material into the People of the Twenty-Five-Foot Raised Beach, with which are included neolithic skulls from bogs, and the People of the Megalithic Monuments is convenient and leads to interesting results, though the division must be regarded as of culture rather than of time.

Perhaps the result of Dr. Martin's researches which will be of most general interest is the evidence which he presents for the existence in the Irish Early and Middle Bronze Age of a broad-headed people comparable with the Beaker People of Great Britain, though accompanied in their burials by " food-vessels " instead of beakers. The solution of the origin of this people and the explanation of the almost total lack of beaker pottery in Ireland would be a most important piece of prehistoric research.

Cremation accounts for the paucity of material in the period following Middle Bronze Age times, but such as is available is dealt with. Burials under the heading of " the Iron Age " are varied in the manner of interment, and the amount of material is small. Skulls from *crannógs*, from Early Christian, and from Norse burials, as well as some of unknown date, are dealt with. A summary of results is given in the final chapter, and the list of references is not only a good documentation of the pages which precede it but is also of great interest because many of the sources upon which it draws are such as might otherwise be easily overlooked.

We shall indicate certain minor points on which we fail to find agreement with the author. A greater importance might be ascribed to the mesolithic as a chronological division and as a cultural phase. There is some ambiguity on p. 72 where forts are made to appear as megalithic structures, while Labbacallee, certainly a megalithic monument, is described as " what appears to be an undoubted megalithic monument " (p. 89). Silver is of much more general occurrence in Ireland than is suggested on p. 104. These and any other points which might be picked out are, however, of small importance and do not affect the general excellence of the work. The publishers are to be congratulated on the attractive format and good illustrations. While we hope with Dr. Martin that the book will stimulate other research in the same field, we feel that it will remain for a considerable time the standard reference work on its subject.

S. P. Ó RÍORDÁIN.

Living Things. By RICHARD PALMER. (Allen & Unwin. 7s. 6d.)

The biological text-book has changed its form. Otherwise, it would be unnecessary to review one in a journal not devoted to teachers, nor would it be possible to describe one as first-class reading matter for any man over the age of twelve. This book is readable, and yet it contains all that is necessary to a sound ground knowledge of living things. Illustrated by diagrams so clear as to be æsthetically satisfying, the thrill of life is still preserved.

The last chapter contains an admirable innovation—a description of the logical methods of scientific inference. If every worker had been trained thoroughly in these simple ideas, years of research would never (as so often) have to be put down as next to worthless owing to the omission of some essential data.

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